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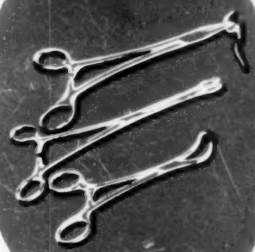

YEAR BOOK *from* HOSPITAL TOPICS

volume four

1953

Printed and Distributed Through the Cooperation of
ETHICON SUTURE LABORATORIES, INC.

Foreword

It is with a great deal of pleasure that we of HOSPITAL TOPICS present this, the fourth volume of the O.R. Yearbook. As did the previous Yearbooks, this volume brings together in a permanent reference form, the important material published in the O.R. Section during the past year.

Editorial matter presented in the O.R. Section is independently selected and prepared by the HOSPITAL TOPICS' staff. The guidance of Carl W. Walter, M.D., and Dorothy Wysocki, R.N., both of the surgical staff of Peter Bent Brigham Hospital, Boston, is gratefully acknowledged.

Ethicon, Inc. financially sponsors the O.R. Section and each year sends individual gift subscriptions to over six thousand operating room nurses.

Gordon W. Marshall

Publisher

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Table of Contents

Methods of Sterilization
Carl W. Walter, M.D. 4

The Blood Vessel Bank 19

Methods of Training O.R. Personnel
Lt. Doris E. Nelson, N.C., USNR 20

The Technic of Assigning Work 23

Safety in the Operating Room
George A. Wiltrakis, M.D. 24

Thermometric Equivalents 28

Work Simplification
Fred E. Markus 30

O.R. Experience Is Indispensable in Student Education
Sister Blanche, O.R.S. 38

Book Review
Operating Room Technic 41

Role of the Doctor
Morris Nicholson, M.D. 42

Art of Administration
T. Stewart Hamilton, M.D. 44
Factors in Purchasing Supplies for the O.R.
A. H. Matthewson 47
Large-Scale Syringe Washer 51
A Progress Report on Operating Room Management 52
A Reappraisal of Absorbable Glove Powder
D. Marshall Lee, Jr., W. T. Collins, M.D., and T. L. Largen, M.D. 54
Question Box
Carl W. Walter, M.D. 73
Technic for Prevention of Severe Hypothermia During Infant Surgery
Edgar A. Bering, Jr., M.D. and Donald D. Matson, M.D. 80
Book Review
Surgical Nursing 83
Electrostatics in the Operating Room
Carl W. Walter, M.D. 84
Training Technicians for the Operating Room
Marie E. Zulauf, R.N. 89
Neurosurgery as it Pertains to the O.R. Nurse
John Griffin, M.D. 92
Question Box
Carl W. Walter, M.D. 98
Safety from Anesthetic Explosions in Hospital Operating Rooms
Robin Beach 103
ICS Holds Three-Day Meeting for O.R. Nurses 120
Scrub Caps 126
How to Dye Operating Room Linens 127
In-Service Education in the O.R.
Edyth Alexander, R.N. 129
Training Technicians for the O.R.
R. A. Cramer 133
Question Box
Carl W. Walter, M.D. 135
The Surgical Armboard 138
The O.R. Problem Clinic
Edith Dee Hall, R.N. 139
Around the A.O.R.N. Map 145
Portland, Ore., A.O.R.N. 146
Oahu, Hawaii, A.O.R.N. 147
Panhandle A.O.R.N. 150
Central Arkansas A.O.R.N. 151
Texas Groups Form a State A.O.R.N. 152
Peoria A.O.R.N. 154
Corpus Christi, Tex., A.O.R.N. 155
Memphis, Tenn., A.O.R.N. 156
Albuquerque A.O.R.N. 157

Methods of Sterilization*

By Carl W. Walter, M.D.
Surgeon, Peter Bent Brigham Hospital
Boston, Mass.

Left: Dr. Walter explains the method of using an instrument washer to Edythe Angell, ORS, (l.) and Eleanor Marobella, assistant ORS, both of University Hospitals, Cleveland. The photograph was taken during Dr. Walter's course in aseptic technic given in Cleveland.

● I welcome the opportunity to speak to operating room nursing groups, largely because I can remember the days when it was a triumph to get any two operating room nurses from any two hospitals in the same city together, and it has been very stimulating to watch this group grow and to see benefits come to patients, to the profession and to hospitals, simply because you have an opportunity to meet and exchange ideas and are beginning to realize that you are an important part of patient care.

As you go on and grow and assume more responsibility and help to pattern thought in the field, patients will benefit more and more.

I shall try to illustrate that during the talk.

I have been a little puzzled as to how to talk about sterilization in an hour, when it really takes several days to cover the subject adequately. However, I thought that we might sort out some of our ideas on the subject by a brief review of the various types of sterilization available, trying to point out the pitfalls and trying to show you why hospitals can sit and dream of high voltage equipment and cosmic ray or electronic sterilization, and may feel very modern, but the real task, as far as applying sterilization in hospitals is concerned, is going to be to understand the simple things, like steam and boiling water, which can be used every day at a minimum expense and which really do the job well and very simply, without introducing heavy expenses for capital equipment and heavy charges for maintenance and without making the sterilizing process a real technical feat, rather than an ordinary, every-day accomplishment.

I mention this largely because at the International College of Surgeons' meeting in Chicago, where I spoke before the Operating Room Nurses' Association, there were several discussants on the floor who kept saying that problems of sterilization would all be solved with electronic sterilization. Everybody had an idea that this was right around the corner.

One of our big problems, however, is learning how to use boiling water, so that patients will be safer and less money will be spent in the process.

There are several ways of destroying organisms, and, strangely enough, they all involve the same, basic problem. The first one which you all use is chemicals. The big problem with chemical disinfection is to get a toxic chemical in contact with all the bacteria. This problem is complicated by the fact that bacteria usually grow in some sort of culture medium; this culture medium coats the bacteria, and prevents adequate contact beween the organism itself and the chemical which you use in the attempt to destroy it.

Other things, such as grease, finger prints and oil on the skin, render the bacteria more or less waterproof, and chemicals do not contact the bacteria at all.

So we have the problem of getting good control of the interfaces, between the organism and the chemical. It is a matter of cleanliness, being certain that the germicide is exhibited to the organism in the optimum quantity and long enough to destroy the organism.

Unfortunately, things are not quite that simple, be-

* *Paper presented at the two-day institute on operating room administration and nursing sponsored by the Massachusetts Organization of Operating Room Nurses, Unit I.*

cause some organisms produce spores, which are much more resistant to chemical effect. The viruses are not affected by chemicals at all.

Whenever you use a chemical, remember that there are none known to date which destroy bacterial life reliably each time. Even 100 percent at any exposure with all of them, if used even under optimum circumstances, certain organisms will survive, and we either do not know how to culture them or we do not culture them long enough.

In most clinical situations, this is of little importance. But, in others, it is of great significance. For example, the virus of homologous serum jaundice will survive contact with all known chemicals and will perpetuate the disease in a human being, even when you have minute inoculations of that organism.

So that for patient care, the chemical disinfection of instruments, needles, syringes and that sort of equipment is quite impossible if you want to prevent widespread epidemics of homologous serum jaundice.

Therefore, the use of chemicals in becoming more and more limited to a field where heat cannot be used. Disinfection of the skin, for example, is one situation where it is the best technic available.

Now, there are many who think of carboxide gas, which is ethylene oxide, as a method of chemical sterilization. Indeed, that is true, but again, it does not destroy one hundred percent of the organisms, and, as ordinary hospital supplies are made up and handled, it isn't a reliable or thoroughly feasible method of sterilization.

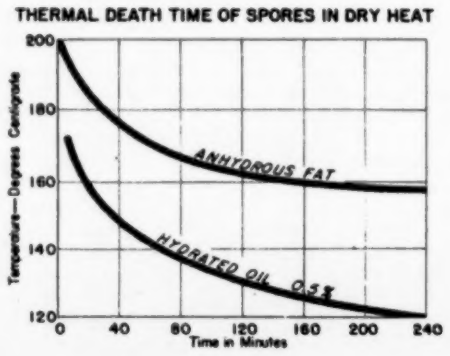
The other method is physical destruction of bacteria, and we can go on and mention a great many of them. There is the cosmic ray, ultra-violet, etc. They are all expensive and difficult to use. The easiest and the most applicable one is heat.

TWO FORMS OF HEAT

We have two forms of heat to consider in sterilization. One is dry heat, and the other is moist heat. Dry heat is advantageous for many reasons, one being that it does not destroy finely polished edges, so that cutting edge instruments, such as scissors, osteotomes, etc., are best sterilized in dry heat; and, it does not attack glass.

As for syringes, grinding removes the annealed protective film, and makes the surface subject to attack by moisture, whereas you can sterilize them repeatedly in

Figure 1



dry heat, without wear and tear. If you use moist heat, the silicon is leached out, and the syringe leaks.

The other reason dry heat is good stems from the fact that the temperature developed is hot enough to destroy bacterial life of itself, so that you don't have to worry about grease, protein, etc., interfering with sterilization.

Accordingly, knife blades, with finger prints on them, and scissors, with grease on them, can be sterilized by adequate exposure to dry heat.

There are two temperatures which are used (Figure 1): 121 degrees centigrade (250° F.), for four hours, is one period, which is thoroughly safe; another is 160 degrees centigrade (320° F.) for one hour. That will give you some concept as to the time required. This is the actual temperature of the instrument you wish to sterilize. It may take a half hour to an hour and a half to heat the sterilizer from room temperature to sterilizing temperature, and once you get it there, it takes an hour at 160° C. to sterilize, and one to one and a half hours for the sterilizer to cool so that the instruments are safe to handle.

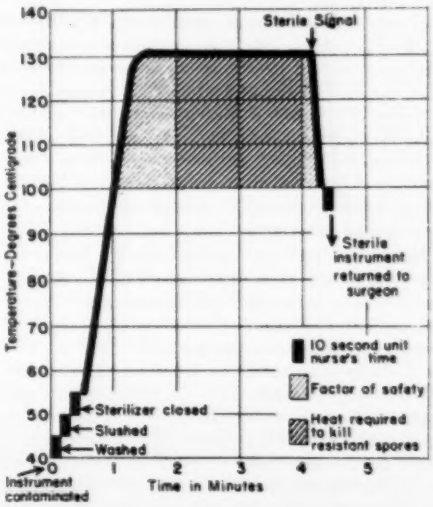
It is important to remember that an instrument at 160° C. (320° F.) is hot enough to give you a severe burn, if you happen to touch it with your fingers.

Most dry heat sterilizers work best if you load them at night, and have the sterilizing cycle go on, overnight, and then your instruments are ready for use the first thing in the morning.

When sterilizing syringes, the clean plungers and barrels are assembled, and a little plastic tip is put on the end of the syringe. You can load several thousand syringes in the steam sterilizer; turn the heat into the jacket, and close the door. You do not turn the heat into the chamber and you just leave them there all night. By the time you come back in the morning, that load will have heated to 121 degrees C. (250° F.), the heat being supplied by the steam in the jacket, and you will have left

Figure 2

PROCESS CHART — EMERGENCY STERILIZER



it there four or more hours at 121 degrees C. (250° F.), and when you unload the sterilizer, you have thousands of clean, dry, sterile syringes, ready for use.

The same sterilizing technic can be used for surgical instruments.

ACCURATE CONTROL

The big problem is accurate control of temperature and accurate timing so that you get exposure adequate to destroy the bacteria.

Moist heat presents several problems which we should discuss. We can choose various degrees of temperature, depending upon how much time we have available to do the task at hand. If you take a high temperature, such as 130° C. (270° F.), the bacterial thermal death time drops to a point where it takes less than two minutes to destroy the most difficult resistant spore that you can produce. Hence, you have a good means of emergency sterilization of instruments in steam, 130 degrees C., 27 pounds pressure. (Figure 2)

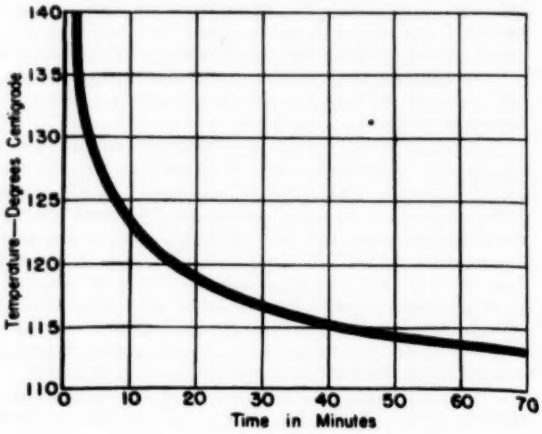
That degree of heat is too severe for rubber goods, and it is destructive of textiles, so that we like to use lower temperatures for this type of supply. We choose 121 degrees C. (250° F.) for more routine sterilization, where time is not an important factor.

Here, we have a thermal death time of 13 minutes, for contact between the steam and the bacteria, so that we can be sure of destruction of bacteria. (Figure 3)

Then, in many hospitals, where you do not have steam sterilization you must rely on boiling water, which at sea level is 100 degrees C. (212 ° F.); unfortunately, that is not a sufficiently high temperature to destroy dry resistant spores or to destroy bacteria, protected by the grease and oil which surround most bacteria in hospital practice.

Figure 3

THERMAL DEATH TIME OF RESISTANT SPORES



THREE LEVELS OF MOIST HEAT

We have, then, these three levels of moist heat that we can consider here. 130° C. (270° F.) for speed; 121° C. (250° F.) for practicability; and 100° C. (212° F.) for

sanitization. There, you have it, 130° C., 121° C., and 100° C.

We have the same problem of making certain that the steam contacts the least accessible spore on the article you wish to disinfect that we have with chemical disinfection. Here, we must recognize that the same principles which interfere with chemicals, also interfere with the action of moist heat. For example, a layer of grease or oil on the outside of a spore or a bacterial culture will delay the lethal effect of that heat for many hours. Therefore, if you package your bacteria in an insulating package, so that the moist heat cannot penetrate to the depth of the package, you should not be surprised to find that the bacteria survive exposure to the steam.

We are not talking about exposure of the package to steam; we are talking about exposure of the bacteria in the center of the package, the least accessible portion of the package to steam.

So that you can immediately see that we have three problems. One is the problem of destroying the bacteria on a clean, dry instrument, where essentially there is surface contact, as contrasted with the problem of sterilizing the bacteria, extended in a litre of water, where your big problem is to heat the whole flask of solution to sterilizing temperature first, before you can depend upon that temperature to destroy the bacteria, or, a third problem, that of heating the entire package of textiles, which you call a laparotomy kit, to 121° C., so that the least accessible spore in the center of that package will be at 121° C., and you can begin to time your thermal death time accurately.

You can see the limiting factor in all of these circumstances is the largest package or flask you have in your sterilizer.

You then make the decision in timing; whether you are going to have a very complicated system in your sterilizing room, of dividing all the packages into lots of small ones, little ones, big ones, or whether you are going to be more or less standard about it and choose a period safe under all conditions, no matter how large the package is, and thus sterilize large packages along with a lot of little ones, which could have been done in less time; but, for the sake of standardization and for the sake of convenience, are loaded in the sterilizers and done all in a uniform period of time.

When it comes to flasks of solutions or bundles of textiles, the simple practice is to adopt a standard period for sterilization, such as thirty minutes, after the exhaust line temperature gets up to 121° C. (250° F.) (Figure 4)

For surface sterilization, such as with instruments, your problem is a little simpler. The problem is only on the surface of the instruments, and you can save a great deal of time using 121° C. for 15 minutes. For emergency sterilization, three minutes at 132° C. will be adequate to sterilize a clean, grease-free instrument.

The various factors which enter into the consideration of timing, I don't think are worth discussing here, if you will concede that the most important thing that you must know in a sterilizing room is that all the material has been adequately exposed, and that everything that comes out of the sterilizer is sterile. That focuses your attention immediately on the largest flask, and on the largest kit, and you make sure that that is packaged properly, and that it is sterilized properly, and you can be equally

A RELIABLE CONTROL FOR STEAM STERILIZATION

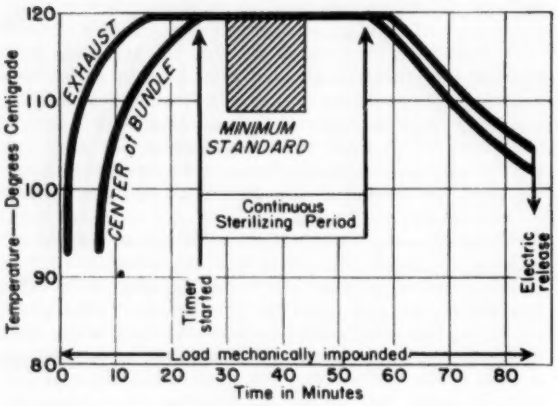


Figure 4

certain that all the other materials in the sterilizer are also sterile, whereas if you allow the operators some latitude to judge the timing on each load, you are quite likely to run into the circumstance where the occasional large package gets by or where large flasks get timed for the same period of time that the small ones have, and you come up with a disaster for some patient.

The only excuse for cutting time is to increase the capacity of small sterilizers; that is, the daily output of small sterilizers, or to protect textiles or solutions from destructive action and heat. The latter is not a factor because the destructive effect of steam exerts itself during the initial heating to the sterilizing temperatures, and once you get it to that temperature, 121° C., steam is not destructive to any of the solutions used in hospital practice, which can be sterilized, or to any of the textiles.

It is the heating and the cooling which do the damage, so you can keep it at the temperature you want, as long as you wish, and if the solutions are made up properly, and if the packages are properly wrapped, you will not get into difficulty.

Now, to time a package of textiles presents, I suppose, the best example of the problem, in running your steam sterilizer. First of all, you have to provide enough steam to penetrate the complete package. When it penetrates the complete package, there are several things that steam must do. The first thing it does is to satisfy the thirst of the textile fiber for moisture. Textile fibers take in a great deal of moisture, to keep themselves in equilibrium with the relative humidity of the air.

During August, and the summer months, the amount of moisture is very great, and you have saturated textiles. Any of you who live in this part of the country are certainly familiar with the fact that you go to bed on a humid night and the sheets feel clammy and wet and don't seem to have any power of absorbing any more moisture. They are one hundred percent saturated, and will weigh twenty percent more in August than they do in December, when they dry out, due to the fact that the relative humidity of the air in the steam-heated room is very low.

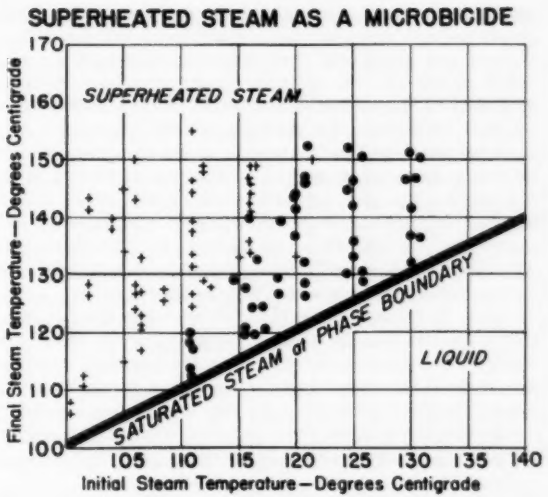
So that if you put sheets into a sterilizer in August, the only temperature energy which is expended is that necessary to heat the sheet from room temperature to sterilizing temperature. Once it is heated, you then begin to time the period for the destruction of bacterial life.

If you take this sheet and try to sterilize it in December, when it is dry, then the energy exchange is determined by the amount of water which is absorbed into the textile fiber, during the process of heating, and you will find that the energy is greatly in excess of that necessary to heat the textile from room temperature to sterilizing temperature, and you have, in the process of supplying moisture to that package, a great deal of extra energy, which goes to heating the package, and these temperatures will often get sufficiently high to actually char the textile, and you see chocolate brown or burned-looking or burned-smelling textiles come out of the sterilizers, where the maximum temperature was only 121° C.

This presents us with one of the problems of steam sterilization—to be sure we are using the temperature we think we are using. We do this by making certain that the textiles are saturated with moisture, when going into the sterilizer. In the summer months, it presents no problem; nature does it for us.

As soon as steam heat is used in the hospital, we have to think about the state of hydration of textile fibers, and this involves taking them directly from the laundry and sterilizing them before they can dry out, or it means spraying them with a spray of distilled water, to hydrate them, before putting them into the sterilizer. This is important because super-heated steam is not a good steril-

Figure 5



izing agent. It is essentially dry heat. If you take steam at 121 degrees, and apply 40 degrees of super-heat to it, you get 161 degrees. You take ordinary moist heat, and you add extra energy to it, and you have dry heat, which is effective the range of an hour exposure, rather than in the shorter period we like to use.

The other important fact, of course, is that as far as rubber goods and textiles are concerned, the super-heat

destroys the textiles and rubber goods.

The culture which you put into steam at 121 degrees for 13 minutes will come out sterile; in super-heated steam at 161 degrees, the same culture will come out unsterile.

You can easily see that from this slide (Figure 5), which shows you the difficulty with super-heated steam. The slide is simply a thermal death time, a curve where we start with steam, for example, at 121 degrees.

With the ordinary steam in a steam sterilizer, we add to that extra energy which in this case is furnished by the energy liberated as textiles are hydrated. You can see that at 121° C. the steam will give you negative cultures. As you add 10 or 15 degrees of super-heat, you soon get to the stage where you find positive cultures. You begin to get those which are troublesome.

Now, in a hospital package, the super-heating is more severe on the outside, largely because that is where the energy exchange occurs. You have the paradoxical situation that it is quite possible to get a laparotomy kit sterile in the middle because the moist steam actually develops in the middle of the package, whereas the periphery of the package may not be sterile.

CONTROL AMOUNT OR MOISTURE

One thing to control in moist heat, and I am talking about textiles now, is the amount of moisture present when those textiles are placed in the sterilizer. In the winter months in a steam-heated room, saturate them with moisture before putting them in the steam sterilizer, first, to get them sterile, secondly, to be sure you do not destroy the textiles needlessly, during the sterilizing period.

Another thing to do is to be sure the packages are wrapped and packaged so that steam can get to the center of the package in the time which you wish to employ.

If you take a period of thirty minutes as your standard, then you have got to know how long it takes for steam to penetrate to the center of the largest package, in order to be sure that the least accessible spore will be exposed to saturated steam for an adequate time.

There are several ways of accomplishing that. The easy way, I think, is to imitate a standard package which has been developed for this purpose. If you prefer you can study your own packages, and your own arrangements. There are many pitfalls in the method, and it is tedious,

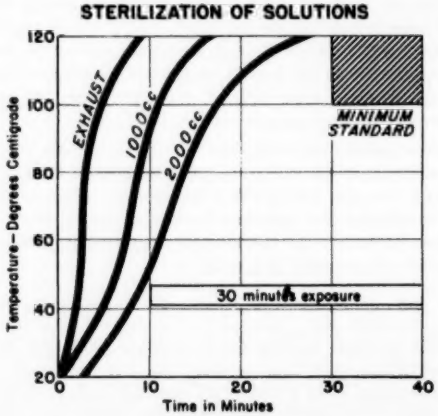


Figure 6

and when you come out with the answer, it is not likely to be much different than the type of answer which others have gotten, working in the field.

PACKAGE MUST ALWAYS BE THE SAME

The thing to consider when you develop a package technic are roughly as follows:

You have got to be sure that the internal arrangement of the package is always the same. You have got to recognize the fact that the package has got to be made up in a perfectly standard manner, size and shape, so that when it is loaded into the sterilizer, the penetration time will always be the same.

In thinking about that, we arrived at a standard size and shape, which fit the sterilizer carriage best. We tried to get the package arranged so that it would contain all the supplies for a standard, major surgical procedure.

This was hard to standardize, for size and shape, until we developed a wooden trough, which gave us length, depth and breadth, and a routine size for a standard package.

The internal arrangement is such that the largest sheet is rolled to give us an accurate division of the big package into four smaller ones, and we, by experimentation, then determined that it takes around 12 to 13 minutes for the center of the package to get heated to 121 degrees. Knowing that, you then give it 13 minutes for the thermal death time, and you have conditions which are fairly standard and can be relied upon to give you sterile textiles.

The question then arises, where do you measure the temperature for this type of device?

You can measure it with a thermocouple in the center of the package; but, that is expensive and difficult to do. It is much easier to measure the temperature of the steam being used in the sterilizer and then rely upon the experimental knowledge that if you use that kind of steam, your package will be heated in a certain period, and will be sterile thereafter.

You will, finally, rely upon a chart such as Figure 4, where you take the temperature in the exhaust line of the sterilizer; when it reaches 121 degrees C., you know from experiments that the center of the bundle is also getting hot; in 15 minutes after the exhaust line temperature reaches 121° C., the center of the bundle is 121° C. Then, you have this minimum standard of 13 minutes thermal death time, and the whole, continuous, sterilizing period can be standardized, with 30 minutes for accomplishing this end.

I think that that is a simple, easy way of accomplishing the result.

The only way that you can get into trouble, from the point of view of the patient, is to change the internal arrangement of the package, so that this time-temperature relationship no longer pertains.

Now, from the point of view of sterilizing solutions, we have a little more difficult problem, in that we have to allow time for the energy to be exchanged across the surface of the flask in which you have the solution. The steam heats the glass; the energy has to go through the glass, and heat the solution inside the glass. This varies with the thickness of the glass, and with the kind of solution that you have.

This same chart which you saw before, now looks like this. (Figure 6). The exhaust line is 121 degrees.

You can see that a 1,000 cc. flask takes 10 minutes; 2000 cc., 30 minutes. That is determined before you apply the minimum standards.

Now, a small flask of 50 cc. would heat much more quickly.

Then, too, you would have to have a longer standard period for a bigger flask. A very thin-walled flask, of 2000 cc., would come up in the neighborhood of 10 minutes, whereas a thick-flask would come to temperature in 20 minutes. And so the container has something to do with the rate at which the solutions come to temperature.

You have a set of problems, with the flask of solution, or any kind of liquid, which does not exist in the dry materials, because you have fluid at 250 degrees in equilibrium with steam at 15 pounds pressure. You wish to take it out of the sterilizer. You first have got to get rid of the steam pressure, so that the sterilizer can be opened. If the pressure is vented the solution at 250 degrees will boil, until enough steam has been given off to cool the solutions to 212 degrees.

In the sterilizer, we accomplish the cooling by turning off the steam supply to the sterilizer, and permitting the whole sterilizer to cool down to 212 degrees, where a liquid will then be in equilibrium, with atmospheric pressures.

If you vent the steam from the sterilizer, your solutions will boil vigorously or they will splatter the contents of the flask out into the sterilizer, or may concentrate to the point where they are no longer useful as accurate solutions.

So that sterilizing solutions differ from textiles in that the end of the cycle must be managed very carefully.

When it comes to instruments, we have other factors introduced with reference to the steam sterilizer. We have tried to figure out exactly what is the heating time. One factor is the grease contamination on the instruments, which prevents moisture from getting to the bacteria, to make the degree of heat which is used effectively in the short period at your disposal.

This comes down to recognition of the hazard and trying to keep grease and oil out of the sterilizer. Instruments which are sterilized in steam must be protected from all contacts with grease and oil, and must be cleaned mechanically to be sure that they are free of oil and grease, each time they are used.

When you consider methods of cleaning instruments, I would invite you to look at the ordinary Charlab, a device developed for washing laboratory glassware, in bulk, and in which you can put an accumulation of the morning's instruments, and run them for an hour with a detergent, getting them free from oil and grease. Then, you can expose them to dry heat to dry the joints and locks thoroughly and store the instruments without the need of oil or grease to protect them from corrosion. In this way, you can sterilize instruments in the steam sterilizer with reasonable safety.

The other problem with instrument sterilization is to be sure that steam can contact every surface, and that there are no air pockets in which bacteria escape contact with steam.

Two big problems here are the rubber tube and the ordinary rubber bulb. For example, the syringe bulb. If you just pick it off the shelf and put it in the sterilizer,

the steam never gets inside because the air remains there. Or, take a long coil of rubber tubing; the air in the tubing is not purged from the lumen during steam sterilization, and the contents of the lumen go unsterile.

The way to avoid this is to rinse out the lumen of the tubing, or actually aspirate water into an Asepto syringe bulb, and flush it out; the film of water in that bulb or tubing is sufficient in quantity so that when the steam heats the rubber, the water will turn to steam and the steam will purge the air.

It takes very little water inside the lumen of a tube, or inside the hole or the hollow of a syringe bulb to purge the air. There is an enormous increase in volume, driving the air out of the channels, and permitting actual contact between the bacteria, and the steam, which is formed inside the tubing, and inside the rubber bulb.

Many folks forget that we are interested in the insides of these things. I saw a nurse the other day take a coil of tubing, hold it under the faucet and then put it into the steam sterilizer; she went through the motions, but she did not bring the patient the safety she should have. Water which should have been inside was on the outside, where it was not needed because as steam contacts a cold object, it condenses and furnishes its own moisture. But by the time it would reach the inside of the tubing, the tubing is hot; and no condensation forms. You then have inside the tubing a dry-heat sterilizer, where it takes four hours to do the work you can do safely in 13 minutes, if you have moisture present.

Remember, then, that in the sterilization of instruments, we have problems of grease, oil, and air-pockets.

To get things done more speedily, we raise the temperature, and this technic is best for emergency sterilization of instruments, where you want to sterilize extra instruments, or where unexpected pathology has been found. A three minute period at 131° C. is adequate for this purpose. (Figure 2)

The limiting factor in most hospitals for satisfactory use of equipment for this purpose is the fact that the steam supply is inadequate, and hence, you do not get prompt and really efficient emergency sterilization.

Because emergencies occur repeatedly, an emergency sterilizer should be a small one, so that it is not useful for other things. You can gear your technic to small kits of instruments, realizing that you can get additional ones to the field quickly. For example, a bone plate that somebody has carefully prepared at the last minute pops out on the floor; you can wash it, remove the grease from it in a fat solvent, put it in a sterilizer, and, with an adequate steam supply, you can get it back to the surgeon in four and a half minutes, absolutely sterile.

The fact that you have this kind of sterilizer in the sterilizing room allows you great latitude in the selection of instrument kits. With basic kits, and with an alert person, you can keep ahead of the surgeon's needs, as long as you have five minutes' time. But, it is difficult if you have to wait a half an hour, or even fifteen minutes, for an ordinary low pressure or 250-degree F. steam sterilizer.

How does all this compare time-wise?

With the chemicals, exposure, with the best chemicals we can devise, is three hours. For boiling water, it is 30 minutes at 121° C. (250° F.)

You can see that there is an advantage in using steam,

You can see that a 1,000 cc. flask takes 10 minutes; 2000 cc., 30 minutes. That is determined before you apply the minimum standards.

Now, a small flask of 50 cc. would heat much more quickly.

Then, too, you would have to have a longer standard period for a bigger flask. A very thin-walled flask, of 2000 cc., would come up in the neighborhood of 10 minutes, whereas a thick-flask would come to temperature in 20 minutes. And so the container has something to do with the rate at which the solutions come to temperature.

You have a set of problems, with the flask of solution, or any kind of liquid, which does not exist in the dry materials, because you have fluid at 250 degrees in equilibrium with steam at 15 pounds pressure. You wish to take it out of the sterilizer. You first have got to get rid of the steam pressure, so that the sterilizer can be opened. If the pressure is vented the solution at 250 degrees will boil, until enough steam has been given off to cool the solutions to 212 degrees.

In the sterilizer, we accomplish the cooling by turning off the steam supply to the sterilizer, and permitting the whole sterilizer to cool down to 212 degrees, where a liquid will then be in equilibrium, with atmospheric pressures.

If you vent the steam from the sterilizer, your solutions will boil vigorously or they will splatter the contents of the flask out into the sterilizer, or may concentrate to the point where they are no longer useful as accurate solutions.

So that sterilizing solutions differ from textiles in that the end of the cycle must be managed very carefully.

When it comes to instruments, we have other factors introduced with reference to the steam sterilizer. We have tried to figure out exactly what is the heating time. One factor is the grease contamination on the instruments, which prevents moisture from getting to the bacteria, to make the degree of heat which is used effectively in the short period at your disposal.

This comes down to recognition of the hazard and trying to keep grease and oil out of the sterilizer. Instruments which are sterilized in steam must be protected from all contacts with grease and oil, and must be cleaned mechanically to be sure that they are free of oil and grease, each time they are used.

When you consider methods of cleaning instruments, I would invite you to look at the ordinary Charlab, a device developed for washing laboratory glassware, in bulk, and in which you can put an accumulation of the morning's instruments, and run them for an hour with a detergent, getting them free from oil and grease. Then, you can expose them to dry heat to dry the joints and locks thoroughly and store the instruments without the need of oil or grease to protect them from corrosion. In this way, you can sterilize instruments in the steam sterilizer with reasonable safety.

The other problem with instrument sterilization is to be sure that steam can contact every surface, and that there are no air pockets in which bacteria escape contact with steam.

Two big problems here are the rubber tube and the ordinary rubber bulb. For example, the syringe bulb. If you just pick it off the shelf and put it in the sterilizer,

the steam never gets inside because the air remains there. Or, take a long coil of rubber tubing; the air in the tubing is not purged from the lumen during steam sterilization, and the contents of the lumen go unsterile.

The way to avoid this is to rinse out the lumen of the tubing, or actually aspirate water into an Asepto syringe bulb, and flush it out; the film of water in that bulb or tubing is sufficient in quantity so that when the steam heats the rubber, the water will turn to steam and the steam will purge the air.

It takes very little water inside the lumen of a tube, or inside the hole or the hollow of a syringe bulb to purge the air. There is an enormous increase in volume, driving the air out of the channels, and permitting actual contact between the bacteria, and the steam, which is formed inside the tubing, and inside the rubber bulb.

Many folks forget that we are interested in the insides of these things. I saw a nurse the other day take a coil of tubing, hold it under the faucet and then put it into the steam sterilizer; she went through the motions, but she did not bring the patient the safety she should have. Water which should have been inside was on the outside, where it was not needed because as steam contacts a cold object, it condenses and furnishes its own moisture. But by the time it would reach the inside of the tubing, the tubing is hot; and no condensation forms. You then have inside the tubing a dry-heat sterilizer, where it takes four hours to do the work you can do safely in 13 minutes, if you have moisture present.

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You can see that there is an advantage in using steam,

whenver you can, and when you can't use steam, you may resort to the use of dry heat—160° C. (320° F.) for 1 hour or 121° C. (250° F.) for 4 hours.

This, to me, is about as much of a thumb-nail sketch of sterilization and its problems as you see them in the operating room, that can be turned out in the brief time, here, without being bogged down with details, and I think that it ought to serve as a springboard for a series of questions, so that I may answer some of your problems regarding sterilization. Therefore, I would propose expanding the rest of my allotted time answering questions.

Chairman Nichols: I have three written out for the problem clinic this afternoon.

Can silicon be used safely and effectively in lubricating joint instruments and the like?

Dr. Walter: Silicon can be used to protect the instruments from a certain amount of corrosion, and will make them work easily. There is no bacteriology to show that it is any different from oil, and it will, theoretically, protect bacteria. I cannot see that it offers any advantage over just plain clean instruments for this purpose. Although I will admit I have not studied the bacteriology of silicons in a steam sterilizer, they are film formers, and they protect instruments from corrosion because they prevent the steam from getting at the steel.

Question: Have you done any experimentation with Patapar paper, and if so, what, and your reactions to it?

Dr. Walter: I have done only preliminary experiments, and my feeling at this time is that it is too waterproof to be used in reliable sterilization. That is, if you are interested in getting a package done quickly and reliably, this paper is a bacterial barrier; it keeps air in and steam out, unless you use it for prolonged periods, in which case you are using dry heat sterilization.

If you use moist sponges, with moist bacteria on them to test, you get good bacteriological results, because the moisture is supplied by the package itself.

But, that is something that you cannot rely upon in the winter months, in a sterilizing room. The problem of running this down and doing the bacteriology is rather an expensive one, and no one to my knowledge has conclusive results.

The bacteriology has been studied in the Meinecke-Dennison double crepe paper, and one layer of that paper is the equivalent of ordinary muslin. But, no one has ever studied the economics of the situation to know whether papers cost more than properly used muslin.

Question: What is your opinion of Weck cellophane sticks for preparing penrose tubing and catheters, for use as opposed to a formalin cabinet?

Dr. Walter: Cabinets are useless. They destroy nothing. The catheters are just as contaminated when they come out as they were when they went in. If they went in nice and clean and washed free of bacteria, they come out that way.

A formalin gas is a dry formalin gas; it just irritates your mucous membranes and makes you feel as though you had done something.

If you put them in a cellophane tube, with one end sealed with a clip, and sterilize them in saturated steam for 30 minutes at 250° F., that is a perfectly satisfactory and safeway of handling them. It is a useful technic. I have not had good luck sterilizing them with both ends

of the tube sealed.

The way to do it easily is to break your paper or your guide or the package at the end, which is supposed to be opened, fold it up and seal it with a clip, and leave the opposite end opened for quick exchange of air and steam. You have got to have moisture inside the catheter, to help get the inside hot, or sterile; then as you remove them, you put a clip on the other end.

Question: A plastic Judet femoral head has been inadvertently contaminated, just prior to use. What is the best or accepted method of re-sterilizing this prosthesis for immediate use?

Dr. Walter: I don't know of any way of doing that. The conventional method is to disinfect them by exposure to germicides. Here, I would think the best chemical to use would be 1:1000 Zephiran, containing formalin, and sodium nitrate. At the moment, I cannot remember the amount. The exposure is three hours for satisfactory disinfection for that type of problem.

That does not answer the problem. What happens, if you contaminate it, and the patient's hip is open? Then you have to compromise with your conscience, unless you have another one to use, which would be the ideal situation.

Would a brief immersion in boiling water, containing 2 percent sodium carbonate, three minutes be adequate? I do not believe it would be enough.

Question: Do you feel that the average majority of surgeons are qualified to tell us about sterilizing technics? Do they have time and/or the opportunity for research as needed?

Dr. Walter: It has been my experience with surgeons that they know nothing about sterilization and they are opinionated about it. They don't think the problems through at all, or the effects on the operating room as a working unit, or as they affect the teaching and maintenance of a technic in the operating room, which can be used by all people safely.

My own feeling is that this is a field where people such as you are much more qualified to express an opinion and to determine a technic than are the surgeons themselves.

The ideal solution of the problem in each hospital is to have a technic committee, usually made up of the youngest surgeon you can find, who has some time to devote to the problem, and who is given the authority for organizing it, along with the operating room supervisor, to set up what will be the acceptable technic. Then everybody should adhere to the technic, for the sake of economy, and also for the sake of the patient who is being treated.

Question: In making up the laparotomy packs, you mentioned spraying them with distilled water. Why do you use distilled water?

Dr. Walter: Largely because tap water has so many salts in it, which make the linens crusty, and plug the nozzle of the atomizer.

Question: What is the plastic that you use on the end of the syringe?

Dr. Walter: Ordinary polyvinyl chloride, heat resistant.

Question: What do you call an exceptional detergent for cleaning?

Dr. Walter: That varies a great deal with the water supply. The non-ionizing detergents, such as Tide, or Joy, are probably as good as you can get in the field. Remem-

ber not to use them in too high a concentration, and to rinse well after use.

CLOSING REMARKS

If there is no other discussion, I should like to close my remarks by pointing out to you that the big problem in sterilization is to destroy bacteria. We know the temperature, and the time required, and I would like to make a plea for a group such as this to clarify their thinking in the field and get together on simple standards, to gain respect from the profession, for a basic body of knowledge in the field, to make teaching easier and to effect some type of standardization at the hospital.

It is perfectly foolish to think that one hospital can operate for years, with one sterilizing period of 30 minutes, at 250 degrees, for everything, and other hospitals have a list as long as your arm, and it takes about six weeks' indoctrination to tell the various attendants what goes where and why and how, and everything is confusion. Furthermore, when doctors go from one hospital to another, everybody does something different, and you can't blame them for beginning to be skeptical, and wonder if anybody knows anything about the field at all.

Much of the confusion has been due to the fact that the people who manufacture sterilizers all like to have a talking point, for their set-up of technic, and perpetuate a very complicated, elaborate ritual, for packaging and wrapping and sterilizing big and little bundles. Others have introduced very tricky thermometers, which are reputed to give you lower temperatures in the sterilizers than are actually used. Others have got one kind or other of control.

All of them carefully keep from being common in their technic, so that they have competitive advantages on bidding for sterilizers, and it introduces hazards to the patients, and confusion to those who have got to teach nurses and train attendants.

I think that it is only by people in groups such as this one recognizing what the bacteriological facts are, and going on to a simple technic which is easy to teach and will bring safety to the patient, which will give us in the long run standardized products that can be used wherever one may be, simply and easily.

That is one of the things that a group such as this can accomplish, and your thinking should not be fooled by all kinds of advertising claims.

Question: Can you suggest any way to go about it? The surgeons don't recognize us as a group, and we are quite young as a group.

Dr. Walter: All you can do is keep pointing out facts, and keep talking the truth and get rid of the confusion in your own thinking. The more you people are confused, the longer the profession stays confused.

Question: When you speak about reading this and that, do you mean that something has been written by other doctors, or the manufacturers?

Dr. Walter: I put out a book once, and in that book there are a lot of references; you can get them if you want to. Or, you can go to the U. S. Pharmacopoeia, and get the official standard for steam sterilization. There are a lot of ways of getting at this, without just going through the advertising literature in the field.

Question: Do you think that we can get the surgeons to read it?

Dr. Walter: You have more chance of getting them

to read a textbook than a lot of advertising brochures.

Question: How does one sell the surgeon the idea that the operating room nurse is efficient, rather than officious?

Dr Walter: I suppose, largely by being efficient.

Question: How do you feel these boundaries could be broken?

Dr. Walter: By giving him service, which is right, and which goes along so well that he doesn't have to pay any attention to it, and thus avoiding jangles.

I believe that efficiency and officiousness are usually just a matter of respect. You respect efficient people, largely because they are never caught off base; they are there when you want them, and they get things done. And, pretty soon, you have a lot of faith and you naturally depend upon them. Maybe that person can give out a lot of guff, to get the job done, and everybody thinks it is wonderful. Along with the officiousness, there is also a performance commanding respect, and a certain reliability.

Then, take the person who makes all kinds of boners, and doesn't run a good department; everybody finds that her end of the stick is dragging every day. She can't be officious or hand out any guff, because she already has strikes against her.

However, if you give efficient service, you can command respect, and you will get to the point where you can talk with people back and forth about problems without giving the impression that you are officious.

There is a lot of difference between knowing your stuff, factually, and turning that knowledge into service which is smooth and efficient and commands respect

The Blood Vessel Bank

● Newest of the banks is the blood vessel bank, which provides living arteries for grafting. At present only a few leading hospitals have established such banks.

After a great deal of research to perfect a means of preserving living blood vessels, a preservative consisting of a number of carefully calculated inorganic salts and human blood serum was developed. A buffer solution was added, and antibiotics were injected to prevent infection of the graft.

Grafts are stored in separate glass bottles which have been sterilized. The bottles are closed with sterile rubber stoppers and placed in a bank in which the temperature is just above freezing. With this method, grafts are kept from four to six weeks. Before they are used, they are checked for contamination.

Grafts are removed in the operating room, within four to five hours after death, under the strictest aseptic technic. They are obtained from patients killed in automobile or other accidents. Extensive tests are made for any evidence of disease which would make the graft unusable.

Blood vessels from banks have been used successfully in cases of coarctation of the aorta and in accident cases in which essential arteries were injured.

Methods of Training O. R. Personnel*

By Lt. Doris E. Nelson, NC, USNR,
U.S. Naval Hospital, Great Lakes, Ill.

A paper presented at the International College of Surgeons meeting.

TRAINING THE TECHNICIAN

A. Aim:

1. To prepare well qualified, nonprofessional personnel in Operating Room Technic and Organization.

B. Objectives of the Program:

1. To encourage the Operating Room Technician to assume responsibility.
2. To further develop his skill.
3. To become self-reliant.

Many of our Operating Room Technicians are included in mobile hospital units overseas where they serve under a Medical Officer and are responsible, under his direction, for setting up the Operating Rooms and carrying on the work therein. Many serve independently on small ships, treating all injuries and sickness, exclusive of major surgery.

C. Qualification Requirements for Students in Operating Room Technic:

1. Students are selected from enlisted personnel who are graduates of the Navy Hospital Corps School. This school has a twenty week schedule of theoretical and practical instruction in the basic subjects and procedures of nursing.
2. They must have a minimum of three months' ward duty.
3. They must be recommended by their instructor, ward nurse, and ward medical officer.
4. Personal interview with the Operating Room Supervisor who checks on educational background, students' reasons for applying for the course, their personal appearance, personality, and temperament suitability.

The responsibility for the teaching and supervision of Operating Room Technicians is that of the Operating Room Supervisor. The course in Operating Room Technic is six months with a minimum number of prescribed hours in didactic and practical experiences. The nurse is assisted in

* *The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.*

her teaching program by her senior corpsman and technicians in charge of the special work details. There is continuity of teaching being done by the surgeons and all members of the operating room staff.

Six students are admitted to the course of instruction with new classes starting every three months. Theoretical teaching and demonstrations are given within the first eight weeks of the course.

Junior students are "scrubbed" for the first time during their third week of instruction, working with and under the supervision of a Technician. As the student becomes more familiar with the surgical procedures, he is given added responsibilities and by the end of his second month, is scrubbing alone for some major cases. At no time during his training is a student scrubbed without supervision of a registered professional nurse.

Surgical watch is stood every third night, each watch being composed of one graduate operating room technician, one senior and one junior student. A professional nurse is always assigned to the surgical watch and she is called for any and all emergencies. The "On Call" service aids in developing ability and confidence for emergency work.

Assignment sheets for the Technician, designating their special work details, are posted monthly; these for the students are posted every two weeks.

Typewritten instructions for sterilization, doctors' preferences, contents of linen packs, instrument kits, etc., are filed for ready reference and students are encouraged to use these files.

METHODS OF TEACHING

Organized classes in Theory.
Doctors' Lectures.
Visual Aids.
Demonstration and Return Demonstration.
Class Discussions.
Personal Conferences.
Required Reading.

In every Operating Room, no matter how busy, there are days of comparative leisure. At such times, we get our students and Technicians together to emphasize new procedures, review old procedures, and have a general checking up and reminder of the usual surgery's DO's and DON'T's.

The diminishing number of trained operating room nurses has forced many civilian hospitals to either close some of their suites, to curtail some of their activities, or to seek nonprofessional help to care for the operating room work. Is the trained Operating Room Technician the answer to this need for more Operating Room Personnel? Let me quote from an article in the Medical Technicians Bulletin for July-August '52. "Why Training" by Lt. Colonel Arthur Stout, USA:

> "The one thing we in the Medical Service cannot buy with appropriated funds is well-trained, hard-working personnel. We must develop them in our schools and training centers for their value cannot be estimated in dollars and cents. Rather it will be reckoned in human lives."

TECHNICIANS

1. Introduction.
   - A. Orientation to Department and Personnel.
     1. Tour of Operating Room Suite.
     2. Introduction to Chief of Surgery, Operating Room Nurses, Operating Room Technicians, Student Corpsmen, and Corps Waves.
   - B. Organization of Personnel and Their Functions.
   - C. Physical Set-up of a Surgery.
   - D. Requirements of a good Operating Room Technician.
   - E. Teamwork Concept.
   - F. Interdepartmental Relationship.
2. Principles of Aseptic Technic.
   - A. Historical Background and Development of Asepsis.
   - B. Sterilization.
     1. Definitions of terms used.
     2. Methods of sterilization.
     3. Preparation and sterilization of equipment and supplies.
3. Suture Materials.
   - A. Types of Sutures.
   - B. Source.
   - C. Uses of various types.
4. Surgical Positions.
5. Housekeeping.
   - A. Care of the Operating Room After "Clean" Cases
   - B. Care of the Operating Room After "Dirty" Cases
   - C. Daily care of Auxiliary Rooms and Passageways
6. Preparation of the Operating Room.
   - A. Duties of the Circulating Nurse.
   - B. Duties of the Sterile Scrub Nurse.
     1. Scrub routine. Gowning and gloving.
     2. Draping of furniture.
     3. Preparation of instruments, needles, sutures, drapes for patient.
     4. Dressing of doctors.
     5. Sponge count.
     6. Stressing importance of absolute aseptic technic.
7. Preparation of the surgical fields, areas to be shaved, sterile "preps".
8. Anesthesia: (Two hour lecture by the Chief of Anesthesia.)
   - A. Types, method of administration, and required equipment.
   - B. Administration of I.V. solutions, Whole Blood, and Plasma.
9. Clerical Work, Records, Forms, Special Chits, Inventory, etc.
10. Instruments.
    - A. Classification.
    - B. Cleaning and Care of Instruments.
    - C. Picking of instruments for cases, special thought for surgeon's preferences.
11. Preparation of Solutions, Packing, and Dressings.
12. Surgical Nomenclature.
13. Central Supply Room.
    - A. Experience to be obtained in C.S.R. during a two-week period.
14. Electrical Equipment.
    - A. Types. Uses of same.
    - B. Explosion and Fire Hazards.

15. Care of Specimens and Cultures.
16. Duties of the Surgical Watch Team. Responsibilities of the Operating Room Technician.
17. Review Classes. General Discussions, Questions & Answer Period.

VISUAL AIDS: TRAINING FILMS

The Chain of Asepsis.
The Enemy Bacteria.
Pre-operative Care & Post-operative Care.
Reamputation and Plastic Operations.
Plastic Operation of the Face.
Plaster Casts.
Care of Hypodermic Syringes and Needles.
Sutures Since Lister.
Setting up an Operating Room.
Draping in the Operating Room.
Duties of the Suture Nurse.
Care and Handling of Sutures.

RECOMMENDED BIBLIOGRAPHY

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SURGICAL NURSING–Eliason & Ferguson. 9th Ed. Rev. Lippincott '50.
SUTURE MANUAL–Davis & Geck.
ETHICON BOOK OF SUTURE–Ethicon Suture Laboratories.
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THE NAVY TRAINED OPERATING ROOM TECHNICIANS–Anna Danyo, A.J.N., Sept. '45 page No. 727.
OPERATIVE PROCEDURES–Ethicon Suture Laboratories.

The Technic of Assigning Work

● In today's on-the-job environment supervisors must motivate—not manhandle people. Of course, the prime requisite in making assignments is consideration by the supervisor of the worker's skills and specific abilities. But it is equally vital that he take other factors into account. Among the more important are:

1. The basic human tendency to resist change or innovation. So far as possible, supervisors must prepare their workers for changes in routine, process, assignment, location, etc. Let them know in advance, and above all, explain reasons for the change.

2. Differences among individuals. All people will not react similarly to a change in assignment. The supervisor's understanding of differences among individuals should include recognition that: (a) different types of jobs are liked or disliked to different degrees; (b) people differ in rates of learning and performing individuals differ in interest, motivation, and response; (d) different degrees of supervisory attention and follow-up are needed for different individuals.

3. Existence of differences among jobs. Most supervisors acknowledge the existence of differences among people but may forget that, in making assignments, these must be tied in with differences in jobs.

By Irving Weinstock in "The Office"—

October, 1952, p. 126

Safety in the Operating Room

The following program and procedures, as outlined in this article, have been adopted by the Department of Public Welfare of the State of Illinois for its various hospitals and institutions.

By George A. Wiltrakis, M.D., Surgical Consultant
Department of Public Welfare, State of Illinois, Springfield

● An explosion occurred recently during an operation in one of the Illinois private general hospitals. The patient died. The physician, the anesthetist and the nurse were not killed. Death of a mother, due to an explosion in the operating room in a Brooklyn Hospital, was also recently reported. In the American Journal of Surgery[1] a total of forty-one operating room explosions were reported; thirty-two of these were due to static electricity. With the use of inflammable gases, the dangers are great. Every possible precaution should be utilized to minimize this danger.

In 1951 the National Fire Protection Association in conjunction with the American Hospital Association, the American College of Surgeons, and the United States Veterans Administration made a careful study of this serious problem and published its report, "Safe Practice for Hospital Operating Rooms"[2] in the N. F. P. A. Bulletin No. 56. Each institution should immediately obtain a copy and comply with the recommendations of this booklet. Compliance with this directive is the superintendent's responsibility. For further detailed information, see "The Handbook of Fire Protection."[3]

The following is a summary of the pertinent data. The safety recommendations listed under "B" were developed with the aid of the Department Fire Marshal, the State Anesthetists, the American Hospital Association, Legge Safety Floor System and Ohio Chemical Company, and other sources. (See references.)

A. GENERAL INFORMATION:

1. **Explosions and Fires**
   a. An **explosion** results when a flammable gas or vapor intimately mixed with air or oxygen or nitrous oxide becomes ignited. Combustion occurs so rapidly, that the products of oxidation

form almost instantly and expand with destructive violence.

b. The following drugs are **flammable**:

Ether	Ethylene
Vinethene	Cyclopropane
Ethyl Chloride	Divinyl Ether

Any of these in a gaseous vapor form, mixed with nitrous oxide, air or oxygen, form explosive mixtures.

c. The following drugs or gases are **not flammable**:

Nitrogen	Chloroform
Carbon Dioxide	Nitrous Oxide
Helium	Trichlorethylene
Oxygen	

d. Ignition of inflammable gases may be from:
   (1) **Flames** such as pipes, cigarettes, alcohol lamps.
   (2) **Electrical Equipment** such as motors, heaters, x-ray equipment, cauteries, switches, lamps, endoscopes.
   (3) **Static Electricity** such as friction from rubber goods, clothing, tearing of adhesive, shuffling of feet or personnel moving about the room.
   (4) **Clicking together of metal parts**, such as slip joints, dropping of instruments.

B. **SAFETY RECOMMENDATIONS:** The following recommendations shall be complied with:

1. **Clothing.** No person shall be permitted in the operating room wearing wool, nylon, silk, or sharkskin clothing. (These garments favor the accumulation of electrostatic charges.)
2. **Shoes.** Shoes with sponge rubber soles or metal tips shall not be worn. If conductive floorings are present in the operating rooms, conductive sole shoes, or conductive booties[4] or other conductive foot devices shall be mandatory.
3. **Blankets.** Woolen blankets shall not be permitted in the operating room. (Danger of electrostatic charges.) Cotton blankets shall be used.
4. **Stool Pads.** No plastic or rubber pads or cushions shall be permitted on stools. The seat of the stool shall be grounded and in direct connection with the floor so as to discharge any accumulated static electricity.
5. **Table Pads.** Avoid rubber table pads or pillow. If used, cover with cotton and do not remove during the operation. (The covering prevents formation of static electricity which results from friction.) If conductive rubber pads are used they shall be grounded.
6. **Cords.** The cords for portable lamps and electrical appliances shall be flexible, continuous, and without connections or switches. They shall be equipped with explosion-proof plugs.
7. **Sockets and Switches.** All sockets shall be explosion-proof unless above five-foot level from floor. All switches shall be explosion-proof if they are less than five feet from the floor.
8. **Motors.** All motors on electrical accessories shall be explosion-proof.
9. **Portable Equipment.** No smoking, cautery, or open

flame shall be permitted in the presence of explosive or flammable anesthetic agents. This includes portable x-ray apparatus, electrical saws, drill, and magnets.

10. **Gas Machines.** All rubber parts of gas machines[6] shall be of conductive rubber. This includes face mask, tubing, bag, and mask retaining straps.
11. **Flooring.** Conductive flooring for the operating room is preferred. Conductive flooring may be painted on the floor.[4]
    a. If hospital has **non-conductive flooring,** the equipment shall be grounded[5] by a resistance protected ground wire. Non-conductive flooring shall be washed with calcium chloride solution (8 ounces calcium chloride dissolved in one gallon of water). This should be done in the evening or morning before surgery is started.
    b. If hospital has **conductive flooring,** arrangements should be made to assure constant contact between equipment and the floors. All mobile equipment shall be equipped either with conductive casters or non-ferrous drag chains. The casters or chains shall be cleaned daily to prevent accumulations of non-conductive coatings such as dust, wax, and soap. The conductive floors shall be maintained by materials[4] which retain conductivity thus eliminating the possibility of an insulating film of soap or wax.
12. **Electrical Service.** For all operating rooms having conductive floors, it is required that electrical service be supplied through isolating transformers and equipped with visual and audible alarms, installed in the operating rooms, to warn of the existence of any ground, in the normally ungrounded circuit.
13. **Air-Conditioning.**
    a. If air-conditioning is not present, circulation or changes of air are important factors in prevention of explosions.
    b. If air-conditioning is present, it shall be checked at regular intervals to eliminate explosion hazards. If equipment is designed to control humidity, the latter shall be controlled, in the operating room areas, within limits of 50 to 55 percent relative humidity. The anesthetist shall be immediately notified whenever the humidity control features of the air-conditioning are not operating because of a breakdown.
14. **Inspection and Report.** The operating room, equipment, and the flooring shall be inspected and tested at regular intervals, at least once a month, by a qualified person in the Mechanical Division of the Hospital and by the Hospital Fire Chief. If conductive flooring is present, this inspection shall include ohmmeter readings[7] of the floor and equipment in order to check for resistances, particularly due to deposits of wax, scum, or soap. A written report of the examination, findings, and corrective action taken shall be recorded in a permanent record in the hospital building.

These recommendations summarize some of the salient features of the National Fire Protection Association Manual No. 56. The latter shall be the guide in establishing and maintaining a safe practice in the hospital operating rooms.

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The O. R. S. On The Job

at South Side Hospital, Pittsburgh

HOSPITAL TOPICS snaps Margaret Gilday (r.), ORS, South Side Hospital, and her assistant, Mrs. Helen Huss, as they check over operating room schedule.

Thermometric Equivalents

(Reprinted from The Pharmacopeia of the United States of America)

Centigrade to Fahrenheit Scales

$$\frac{9}{5}\,C.^\circ + 32 = F.^\circ$$

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
−20	−4.0	21	69.8	61	141.8	101	213.8	141	285.8
−19	−2.2	22	71.6	62	143.6	102	215.6	142	287.6
−18	−0.4	23	73.4	63	145.4	103	217.4	143	289.4
−17	1.4	24	75.2	64	147.2	104	219.2	144	291.2
−16	3.2	25	77.	65	149.	105	221.	145	293.
−15	5.	26	78.8	66	150.8	106	222.8	146	294.8
−14	6.8	27	80.6	67	152.6	107	224.6	147	296.6
−13	8.6	28	82.4	68	154.4	108	226.4	148	298.4
−12	10.4	29	84.2	69	156.2	109	228.2	149	300.2
−11	12.2	30	86.	70	158.	110	230.	150	302.
−10	14.	31	87.8	71	159.8	111	231.8	151	303.8
− 9	15.8	32	89.6	72	161.6	112	233.6	152	305.6
− 8	17.6	33	91.4	73	163.4	113	235.4	153	307.4
− 7	19.4	34	93.2	74	165.2	114	237.2	154	309.2
− 6	21.2	35	95.	75	167.	115	239.	155	311.
− 5	23.	36	96.8	76	168.8	116	240.8	156	312.8
− 4	24.8	37	98.6	77	170.6	117	242.6	157	314.6
− 3	26.6	38	100.4	78	172.4	118	244.4	158	316.4
− 2	28.4	39	102.2	79	174.2	119	246.2	159	318.2
− 1	30.2	40	104.	80	176.	120	248.	160	320.
0	32.	41	105.8	81	177.8	121	249.8	161	321.8
1	33.8	42	107.6	82	179.6	122	251.6	162	323.6
2	35.6	43	109.4	83	181.4	123	253.4	163	325.4
3	37.4	44	111.2	84	183.2	124	255.2	164	327.2
4	39.2	45	113.	85	185.	125	257.	165	329.
5	41.	46	114.8	86	186.8	126	258.8	166	330.8
6	42.8	47	116.6	87	188.6	127	260.6	167	332.6
7	44.6	48	118.4	88	190.4	128	262.4	168	334.4
8	46.4	49	120.2	89	192.2	129	264.2	169	336.2
9	48.2	50	122.	90	194.	130	266.	170	338.
10	50.	51	123.8	91	195.8	131	267.8	171	339.8
11	51.8	52	125.6	92	197.6	132	269.6	172	341.6
12	53.6	53	127.4	93	199.4	133	271.4	173	343.4
13	55.4	54	129.2	94	201.2	134	273.2	174	345.2
14	57.2	55	131.	95	203.	135	275.	175	347.
15	59.	56	132.8	96	204.8	136	276.8	176	348.8
16	60.8	57	134.6	97	206.6	137	278.6	177	350.6
17	62.6	58	136.4	98	208.4	138	280.4	178	352.4
18	64.4	59	138.2	99	210.2	139	282.2	179	354.2
19	66.2	60	140.	100	212.	140	284.	180	356.
20	68.								

Fahrenheit to Centigrade Scales

$$(F.^\circ - 32) \times \frac{5}{9} = C.^\circ$$

F.°	C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°	C.°
0	−17.78	51	10.56	101	38.33	151	66.11	201	93.89
1	−17.22	52	11.11	102	38.89	152	66.67	202	94.44
2	−16.67	53	11.67	103	39.44	153	67.22	203	95.
3	−16.11	54	12.22	104	40.	154	67.78	204	95.56
4	−15.56	55	12.78	105	40.56	155	68.33	205	96.11
5	−15.	56	13.33	106	41.11	156	68.89	206	96.67
6	−14.44	57	13.89	107	41.67	157	69.44	207	97.22
7	−13.89	58	14.44	108	42.22	158	70.	208	97.78
8	−13.33	59	15.	109	42.78	159	70.56	209	98.33
9	−12.78	60	15.56	110	43.33	160	71.11	210	98.89
10	−12.22	61	16.11	111	43.89	161	71.67	211	99.44
11	−11.67	62	16.67	112	44.44	162	72.22	212	100.
12	−11.11	63	17.22	113	45.	163	72.78	213	100.56
13	−10.56	64	17.78	114	45.56	164	73.33	214	101.11
14	−10.	65	18.33	115	46.11	165	73.89	215	101.67
15	−9.44	66	18.89	116	46.67	166	74.44	216	102.22
16	−8.89	67	19.44	117	47.22	167	75.	217	102.78
17	−8.33	68	20.	118	47.78	168	75.56	218	103.33
18	−7.78	69	20.56	119	48.33	169	76.11	219	103.89
19	−7.22	70	21.11	120	48.89	170	76.67	220	104.44
20	−6.67	71	21.67	121	49.44	171	77.22	221	105.
21	−6.11	72	22.22	122	50.	172	77.78	222	105.56
22	−5.56	73	22.78	123	50.56	173	78.33	223	106.11
23	−5.	74	23.33	124	51.11	174	78.89	224	106.67
24	−4.44	75	23.89	125	51.67	175	79.44	225	107.22
25	−3.89	76	24.44	126	52.22	176	80.	226	107.78
26	−3.33	77	25.	127	52.78	177	80.56	227	108.33
27	−2.78	78	25.56	128	53.33	178	81.11	228	108.89
28	−2.22	79	26.11	129	53.89	179	81.67	229	109.44
29	−1.67	80	26.67	130	54.44	180	82.22	230	110.
30	−1.11	81	27.22	131	55.	181	82.78	231	110.56
31	−0.56	82	27.78	132	55.56	182	83.33	232	111.11
32	0.	83	28.33	133	56.11	183	83.89	233	111.67
33	0.56	84	28.89	134	56.67	184	84.44	234	112.22
34	1.11	85	29.44	135	57.22	185	85.	235	112.78
35	1.67	86	30.	136	57.78	186	85.56	236	113.33
36	2.22	87	30.56	137	58.33	187	86.11	237	113.89
37	2.78	88	31.11	138	58.89	188	86.67	238	114.44
38	3.33	89	31.67	139	59.44	189	87.22	239	115.
39	3.89	90	32.22	140	60.	190	87.78	240	115.56
40	4.44	91	32.78	141	60.56	191	88.33	241	116.11
41	5.	92	33.33	142	61.11	192	88.89	242	116.67
42	5.56	93	33.89	143	61.67	193	89.44	243	117.22
43	6.11	94	34.44	144	62.22	194	90.	244	117.78
44	6.67	95	35.	145	62.78	195	90.56	245	118.33
45	7.22	96	35.56	146	63.33	196	91.11	246	118.89
46	7.78	97	36.11	147	63.89	197	91.67	247	119.44
47	8.33	98	36.67	148	64.44	198	92.22	248	120.
48	8.89	99	37.22	149	65.	199	92.78	249	120.56
49	9.44	100	37.78	150	65.56	200	93.33	250	121.11
50	10.								

WORK SIMPLIFICATION

By Fred E. Markus
Markus and Nocka, Boston

• The principles by which work simplification is accomplished in hospitals and in industry are exactly the same. It is, however, somewhat more difficult to introduce work simplification in hospitals than it is in most industries and the returns are rarely spectacular but still are well worthwhile.

At the moment you can learn much more from industry on this subject than you can from hospitals. In time, hospitals will have more to show. Therefore, I am going to give you a number of examples from industry first and then go on to what we can do in hospitals.

In the last issue of FACTORY MANAGEMENT AND MAINTENANCE, there is a several--page article on work simplification. I should like to read the first three paragraphs because they are equally appropriate to your particular problem.

This article is entitled "Case and Methods Improvements at the Burtman Electric Company, Rock Island, Illinois." It was written by James E. Allen, Coordinator of the Work Simplification Program. The two paragraphs are as follows:

"Our work simplification program has been in operation just about two and a half years. The number of proposals submitted to date have been 706, and the number accepted 308. None of them are major projects and no one of them saves a great deal of money. Results: A saving of almost $100,000. Total cost $2,978. We think that is wonderful for a program still in the development stage but it is not the whole story. We do not think that the real value to us can be fully appraised in dollars and cents. For example, as the result of participating in the program, our tool designers now automatically use the principles of work simplification, in developing fixtures, tools, and jigs. They use quick acting clamps, instead of screw clamps. They combine fixtures to eliminate the need to transfer parts from one fixture to another. Our product designers automatically give attention to machining and assembly details. In other words, they are conscious of the production man's problem. Also, we now realize the necessity for developing the best possible processing and assembly methods for manufacturing a new product and training our workers in these methods before releasing it in the shop. We can't give you the dollar figure for the eliminated confusion and delay but it is a big one. Just talking work simplification, we found, would not work. Before we learned the work simplification facts of life, we tried an unorganized approach. We held occasional meetings, to encourage our supervisors to turn in their ideas for methods and improvements to the industrial engineering department. For a while, we got a few good ideas and then, despite impassioned pleas on the need to cut costs to meet competition, the suggestions tapered off. This unhappy experience taught us two things. There was gold in the individual and collective minds of

our supervisors and we needed an organized approach to get at it."

That last sentence applies equally well to hospitals and it is worth repeating—"There *is* gold in the individual and collective minds of our supervisors and we needed an organized approach to get at it." Such an experience might have come from a hospital just as well as a factory.

OUTSTANDING EXAMPLES

By way of a bit of background, let me give you two rather outstanding examples that have made history. They will give you a little insight as to what work simplification can accomplish and where its limitations lie. First, let us consider the laying of brick. No doubt you all know of Frank Gilbreth of "Cheaper by the Dozen" fame. He was a bricklayer originally and eventually became one of the largest contractors in the United States. He was a man with a very curious mind. He noticed that of all his bricklayers, no two used the same motions to lay a brick. So, he raised the question of why there were so many different motions. Which were really necessary and which unnecessary? He took a motion picture camera and photographed his best bricklayers. He found the average bricklayers used almost 18 motions to lay one brick. After considerable study and experimentation, he was able to eliminate all of those motions which had no bearing on getting the brick into the wall. The end result of his study was that he devised a way of laying brick with only five motions.

That is rather startling. It shows what can be done by precise analysis. The chances are that even the Egyptians used 18 motions more or less in their time. This would mean that not the slightest progress had been made for 10,000 years until the event of Mr. Gilbreth and work simplification.

The bricklayer who originally laid 150 bricks an hour could now lay 350 an hour when taught to do so with five motions per brick. Gilbreth was a fair man and he paid the bricklayers on the basis of output. The bricklayers had no quarrel because they naturally earned a lot more money by using the simplified method. This was around 1900.

You might naturally assume that all bricklayers now lay brick with five motions. Not at all. They are still laying brick with the same old 18 motions. Why? Because Gilbreth was able to sell this method only to himself and some of his better bricklayers. He was not able to sell it to anybody else even though it represented a tremendous financial saving in the construction of buildings. Contractors didn't want to bother to teach the bricklayers. They came and went so frequently it wasn't worth the trouble. The unions opposed it because fewer bricklayers would be needed. So, this outstanding piece of work which could save the construction industry untold millions went begging. The publication of this work, however, brought Gilbreth immediate fame and launched him on an amazing career as a consulting industrial engineer.

Let me give you one other example which I mentioned at your May meeting. It occurred during World War II in one of the procurement stations in the United States.

This particular station received orders for various pieces of equipment which the military required—bulldozers, trucks, cars, and the like and then found where the equipment could be obtained, either from their own stock somewhere in the United States or bought new. The

paper work was done by approximately 110 girls under Civil Service. At the time of a new commander taking over, they were three months behind in their work. In other words, if a requisition for a bulldozer was put in today, it would be three months before one would be located on the West Coast.

The head of the clerical department, who was also under Civil Service, was clamoring for more help and as proof of the need took his new supervisor around and showed him how busy everybody was—girls were typing furiously, messengers were running back and forth, and file clerks were opening and closing drawers. But the new superior was not impressed with all this activity. He was a reserve officer, an industrialist in civilian life. He summoned an industrial engineer to make a study of the problem.

PROCESS FLOW CHART

The industrial engineer started by making a process flow chart. The chart was 35' long. When it was completed, the engineer started at the rear end and began to work back by asking the employees what they were doing and why. Many questions were embarrassing. But always, why, why, why? Why eight copies of this form? Who gets them? What do they do with them? And so it went on through reams of forms, red tape, duplications!

When he was through with his questioning, the process of elimination and changes began. He then made a new chart showing his recommended method of doing the paper work. When the work was apportioned out according to the chart, there was only enough for 10 girls. The heaps of paper work were soon disposed of and the 10 girls never got behind again.

The moral, therefore, is that you can't tell by merely looking at a process or a job whether or not it is efficient or inefficient and whether or not there are possibilities for improvement. In other words, if you really want to know the facts about any particular process, you have to make a chart of that process and analyze it.

Our time is limited so with that background, I shall proceed to show you the method of approach. First of all, what is this all about? What are we after? What are the objectives of work simplification?

Various authorities give a number of definitions of work simplification. For example—*To make a better product* or *Give a better service at a lesser cost.* How are we to do this? Generally by the *saving of time* but there are other factors equally important. They are by the *saving of time, space, energy, and/or material.* Any one or a combination of those may cost but we must be sure the product or service is not reduced in quality.

Just to give you an example of how this might work, take an actual case of a ward nurse. She is always about two hours behind schedule on much of her work. Because of this, the service that she is giving cannot be up to par. Therefore, anything that might be done to reduce her time and bring her on schedule would improve the service to the patient.

Take the case of the work of the average recovery nurse. At the end of the day, she is pretty well exhausted. We know that in industry, the accident rate increased towards the end of the day. That is why they introduced rest periods and pushed around refreshment carts. Therefore, we know by the same token that at the end of the day, the service given to the patient in the recovery room

is not on a par with the service that was given in the morning. Consequently, anything that can be done to save energy on her part would improve the service.

On the other hand, studies made on laboratory work show that substantial time savings are possible on routines. Laboratory service costs are reduced and bench space is saved.

The next question might be—how do you proceed?

The methods of procedure have been pretty well standardized. First, *select the job to simplify.* Break it into its elemental components and record on a chart. Next, *analyze the job* and work out a new method in chart form. It is rare that a change involves no initial cost so you next must *estimate the gain* against the cost of making the change. (This is referred to as re-tooling in industry.) The gain has to be sufficient to warrant the expenditure involved. After you have evaluated the change and have convinced your superior that it is warranted and gotten his approval, you go about *acquiring the materials, making the necessary changes, and putting the new method into effect.* The personnel then must be *instructed in the new method.* You must follow up to see that everything works as you had planned.

That in general is the procedure. No matter what the job is, that in general is how you go about it.

WHAT CAN BE DONE IN O.R.

Now, what can be done in an operating room? Fairly standard routines can be picked out here and there and charted for study. A cycle of instruments used from shelf to shelf is an example. Study it, see what happens, and what can be done about it.

Another thing which can be done in operating room

Mr. Markus illustrated his subject material in addressing the Institute on O. R. Administration and Nursing held by the Massachusetts A.O.R.N.

work which cannot be fully standardized is trying to find work patterns. The work will vary in that pattern more or less but the pattern is still there and can be used as a basis of study. During a procedure, keep track of where your circulation nurse goes. Note that she goes a certain number of times to a certain cabinet, a certain number of times to the sterilizing room, a certain number of times she goes outside into the corridor to get instruments, etc. Keep track of the number of these times and places. They might form a certain pattern perhaps triangular and that pattern might stand reducing to a lower common denominator.

Unfortunately, very often things are built in and much of what you might like to do would be financially impractical. The cost would be prohibitive. That is why it is important to determine these basic patterns, these travel patterns and other similar things before a building is built or the room designed.

There are many ways in which you can use space more efficiently. For example, to minimize stooping storage cabinets need not go to the floor. They can stop at some convenient low point. The remaining space can form a ledge to store stools, buckets, basins, stands, etc. When an orderly mops the floor in the average operating room, he just mops one side and then pushes everything over on the other side of the room. Then he mops again and pushes everything back. That moving makes two movements to all of that equipment. When those things are on a ledge, they are placed only once.

In establishing a new method, begin with a questioning approach. Industrial engineers constantly ask questions and are rarely, if ever, satisfied with the answers. *What should be done? Why should it be done? Where should it be done? When should it be done? Who should do it? How should it be done?* He wants to know the real answers to all those questions before he makes a move.

With regards to the last question—"How should it be done?"—we take each element of the selected job and examine it separately. And in the examination, there are five things that we check on: *Can that element be eliminated? Can it be combined with another element?* Is there a *substitution* possible which would do a better job? Can the *sequence be changed* to advantage? Does the job lend itself to *mechanization?*

One of the substitutions frequently used is in the form of motion employed. For instance, chocolate dippers used to dip with an angular motion. They had an instrument with which they picked up the filling, dipped it into the chocolate sauce, and then placed it on the drying pan. Each cycle was composed of three straight motions forming a triangle. It was found that a *circular motion* required less time to cover the same lineal distance because an angular motion means acceleration at the beginning of a motion and then decceleration before each stop. Time is lost and more energy is used. The circular motion flows much easier. When the chocolate dippers were taught to do their work in a circular motion, the output was substantially increased.

Then, there is a question of *balance.* If work is improperly arranged and puts the worker off balance, he will be excessively fatigued at the end of the day. We know, for example, that you can carry two buckets of water with a lesser usage of energy than you can one bucket. With only one, you are out of balance.

The question of rhythm is some what on the same order. If you can establish a work rhythm, you will use considerably less energy. There is an outstanding example of that in the tremendous loads that certain peons can carry for many miles over mountain trails, burdens which the average man can hardly lift off the ground. They do it in a sort of trot. They establish a special rhythm enabling them to keep going hour after hour. However, if somebody disturbs the rhythm, they have a hard time getting back into that rhythmic stride again. Industry makes frequent use of that factor to save energy.

Finally, there is the question of *symmetry*. If it is possible to work out a particular process so that the left hand, let us say, does exactly the same as the right hand but opposite from it, you will have perfect symmetry which is a great aid in getting balance and rhythm.

In charting, to help them get the overall picture of a process, industrial engineers like to use a set of standardized symbols. There are four—the large circle indicating *work*, the small circle indicating *transport*, the triangle indicating *storage*, and the circle inside the square indicating *inspection*. Work is anything, whether useful or not, in the performance of a particular job. Transport is the moving from one place to another, as the hand, the body, or an object. A messenger boy is considered transported. The hand moving from one location to another is also considered transport. The term "transport loaded" would refer to the hand or a conveyance carrying something. The hand moving empty would be called "transport empty." Anything which is stationary for a period of time is indicated with a triangle. That represents storage. Laying a pencil down would be storage. Anything set aside for a short period is called "temporary storage." Otherwise, it is "permanent storage." Finally, you have inspection—where a thing is examined to see whether or not it meets certain requirements. Also, at times you might combine inspection with the processing of a certain piece of work in which case the circle is drawn inside the square. Inspecting instruments during washing or drying would be an example.

FOUR TYPES OF CHARTS

There are four types of charts which are fairly well standardized by industrial engineers. After that, they improvise charts to meet special conditions. These four charts are the "process flow chart," "the right and left hand chart," "man-machine chart," and "micro-motion chart." I think for some time to come, hospitals will have relatively little need for the man-machine chart and the chances are also that the micro-motion chart will play at the beginning a relatively minor role. You will at first work mostly with simple process flow charts. The next most useful form of chart would be the right and left hand chart where you have a double column. In the first column, you record what the left hand is doing and in the second you record what the right hand is doing during corresponding time intervals. Having done that, you proceed the same as with a process flow chart always using the questioning approach. You try to eliminate, combine, substitute, change sequence, or mechanize. Having made your analysis, you establish a new method and record it in chart form on the second half of the sheet. In this case, we are going from an unsymmetrical work layout to a symmetrical layout. The right hand will now be doing exactly the same as the left hand. The bolt and

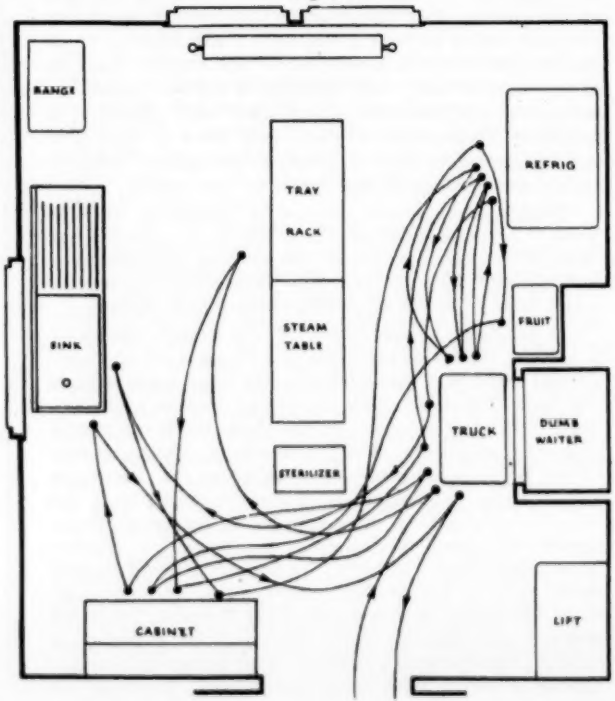
washer assembly is a good illustration of a symmetrical work place layout.

Finally, make work simplification a democratic process in which everyone is privileged to participate. Those in charge also consider the moral implications. No-one must ever be dismissed because his particular job has been eliminated or combined with some other. Rather, the personnel involved should preferably also benefit by advantageous transfers or better yet by outright promotions.

Between Meal Nourishment

The need for a Work Simplification study during planning stages is well illustrated in the travel chart on the preparation of between meal nourishments (figures 4, 5, and 6). It was found here that after a complete renovation of one of several similar ward kitchens that the travel for preparing these nourishments was just as wasteful as in any of the kitchens that had not been renovated. Had a proper study been made in time, the travel could have been reduced in accordance with the third illustration and still integrated efficiently with all other activities in the kitchen.

Figure 4



Diagrams by
Markus and Nocka
Boston

Figure 5

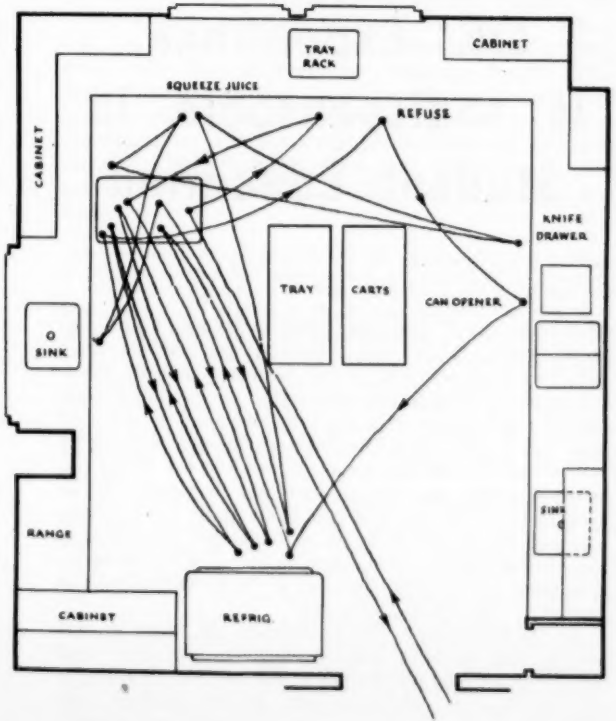
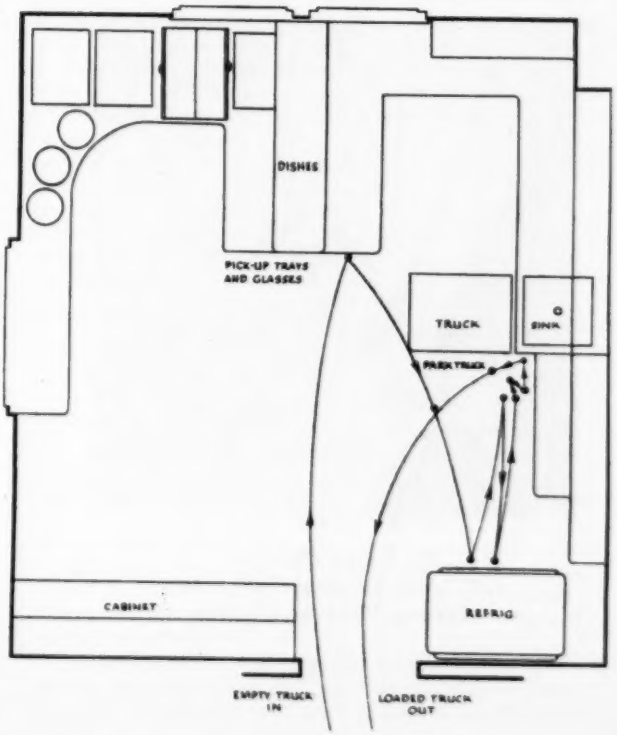


Figure 6



By Sister Blanche
ORS and Surgical Instructor
Carney Hospital, Boston

OR Experience Is Indispensable in Student Education

Presented at the Institute on Administration and Nursing sponsored by M.A.O.R.N.

● In this era of experimentation in nursing school curricula, each area of the traditional program is being subjected to almost microscopic scrutiny. Are its learning outcomes of sufficient importance to warrant the expenditure of a student's time, and if so, how much of that time? The operating room experience is probably one of the most debated areas. It is up to the clinical instructor in this specialty to study her own field with an open mind and to see if it can justly claim any inherent learning values not likely to be duplicated elsewhere in the educational program. The object of this discussion is to point out learning outcomes of the operating room as viewed by one clinical instructor.

In the beginning of her experience, the young student sees nursing as many isolated segments, that must some day be united and clarified as a meaningful whole before she can function effectively. She studies anatomy, sees textbook pictures of organs and structures and wonders

how closely they resemble reality. She observes and cares for patients reacting from anesthesia and wonders how it was actually administered, by whom, and how long it took the patient to lose consciousness. She sees x-ray films which have only abstract meanings for her. She studies various surgical positions but has no occasion to use or see them applied. She prepares the patient psychologically and physically for the operation and welcomes him on his return to the ward. What happened in between the preparation and the return is vague in her mind.

SEGMENTS CONVERGE

Clinical experience in the operating room brings all these segments together. Here she realizes for the first time the importance of preoperative care: the proper emptying of particular body cavities, the wide area of skin preparation, and the reason and underlying principles for medications in relation to anesthesia. She sees patients undergo the several stages of anesthesia and realizes now that patients recover by a reversal of these stages.

The textbook pictures of organs and structures become an actuality as she views them in real life, listens to the doctors' explanations, and sees the position and functions of the organs in relation to each other. She realizes the value of x-ray as a diagnostic aid to the surgeon as she sees the pathology pointed out on the film.

Surgical pathology is taught to the student nurses in its natural setting, the human body. Thus a living aspect of pathology is imparted to the students in the operating room. There is no substitute for this type of first hand teaching. Didactic lectures, preserved specimens, and color photography can augment, but not substitute for this. In teaching appendicitis, there is no better way to indelibly impress the students with the gross characteristics of this disease than by demonstrating it in its natural state in the operating room. Tumor pathology in the various systems of the body can be demonstrated and taught in real life impressing on the students the gross characteristics of benign and malignant tumors. Those congenital anomalies which are amenable to surgery are best demonstrated in the operating room. Is it not quite evident, then, that the teaching of surgical pathology as living pathology can be accomplished only in the operating room?

KEYNOTE TO ASEPSIS

The keynote to O.R. technic is asepsis. Early in her nursing career, the student learns the fundamental principles in her microbiology course. Surgery is the laboratory for this course. Here she carries out the practical application—the preoperative sterilization of instruments, packs, gloves; the taking of cultures from infected organs; rigid adherence to mechanical cleansing of her hands and the operative area of the patient. The student is taught the procedure for the care of a contaminated room after a septic case. Have you ever considered how invaluable is this knowledge, gained by participation and application, to the student who must one day care for a patient on isolation technic?

In the O.R., as nowhere else, the student learns, understands, and appreciates the essential qualities of teamwork and cooperation that must prevail in an efficiently

run department. In the operating room the student learns how to conduct herself with studied dignity at all times. In no situation in the nursing field are these qualities more necessary than in the surgical department. To obtain the best result from an operation, the surgeon, his assistants, the operating room nurse, and the entire staff must work as a team. A unity of spirit, discipline, and understanding —the lubricant of cooperation—permeate the entire personnel. As a result of this experience, the student in surgery develops mentally and gains confidence in herself and in her ability to cope with various situations, for she has had the opportunity of functioning as a responsible member of a surgical team.

Because the student nurse has acquired in the O.R. an understanding of more common types of operative procedures and their relation to the patient's safety and progress, she is better able to give intelligent postoperative care. She now understands why a drain is inserted, why it must have a sterile connecting tube, and why it must be irrigated PRN, why a Wangensteen is ordered, why medication is given for pain after an operation, why the orders read, "watch for hemorrhage," or "nothing by mouth," etc., and many other whys. The rapport she has established with the doctors make her more capable when assisting them with dressings and other procedures.

Armed with these valuable aids, the student with operating room experience behind her approaches the more advanced nursing services courageously. The foundation for obstetrical nursing has been laid and the student applies her knowledge of aseptic principles in scrubbing for deliveries and in caring for the newborn. These aseptic principles so valuable to obstetrical service have been given to the students in a minimum of 30 hours of class with subsequent supervised practice. Lack of this instruction would place at least 15 additional hours of class on an already overburdened curriculum in the obstetrical department.

Just as a physician who is in practice has an obligation to his patients and to his community to prevent illness and to promote family and community health, so has a nurse this same obligation. We hear a lot today about preventive medicine, which is the direct responsibility of the individual in the prevention of disease and in the protection and promotion of health for himself and family. Who could be better equipped than a nurse with a good O.R. experience to guide an individual to a doctor before a simple hernia becomes strangulated, before a lump becomes malignant or before a pain in the abdomen becomes a ruptured appendix?

One of the most convincing criteria which may be used in evaluating any educational program is the participant's reaction to it. In order to find out how nurses and would-be nurses feel about operating room experience, an opinionnaire was given to a group of 100 graduate nurses and senior students. A second opinionnaire was given to a group of 100 preclinical students during their first week in the School of Nursing. Both groups were asked several questions—the former group was to answer these questions in retrospect, the latter, in anticipation.

The graduates and senior students claimed unanimously that they considered their operating room experience absolutely essential and that they did not think that a period of observation in the operating room could have possibly

yielded the same advantages. The preclinical students said that they would feel deprived of a necessary experience in the School of Nursing were operating room experience taken out of the curriculum and an observation period substituted; that they would not have entered a school which did not offer this experience.

It is significant that a large group of graduate nurses who were presently engaged in a wide variety of nursing occupations, including public health, obstetrics, pediatrics, nursing education, nursing administration, private duty, and general staff duty, all recalled their operating room student experience as a valuable part of their educational program. Few of these nurses had been employed in the operating room since graduation. This further substantiates the opinion that operating room has value for all of nursing.

The opinion of the preclinical students is probably largely based on the glamor and thrill attached by the lay mind to the operating room. But the seriousness of many of the answers indicated that some of these young students had a surprisingly correct idea of the educational opportunities awaiting them there.

Without claiming any undeserved value for this very limited opinionnaire study, it at least gives an interesting insight into how 200 persons with varying background view the operating room experience. It is encouraging to clinical instructors in this specialty to know that nurses in many other areas share with them their enthusiasm for the importance of O.R. assignment. It is also encouraging to know that young girls just entering nursing so eagerly anticipate the opportunity of spending a few weeks or months in the operating room.

BOOK REVIEW

Operating Room Technic

By Anna M. O'Neill, R.N., 3rd edition, 1953, 379 pages, illustrated, pub. by F. A. Davis Company, Philadelphia

The part of the hospital which the public never sees is also the part in which the strictest vigilance must be observed. Aseptic surgical technic has reached a high peak, and the results are seen in the low incidence of postoperative infections. But despite this, there are higher peaks which may be attained by even more strict adherence to known principles and the use of a few new weapons.

Author O'Neill includes these newer methods in her text. She discusses the use of the detergent antiseptic in the scrub-up procedure, absorbable hemostatic substances, refrigeration anesthesia, and recent autoclaving methods.

The first half of the book is largely devoted to technic, and the last half to instrument set-ups. Those who are acquainted with the first two editions will be interested in knowing that several new features have been added in the third edition. In addition to the new scrub-up technic, a chapter has been added on dental and oral surgery. The bone bank is described, and several new operations are outlined.

Miss O'Neill is operating room supervisor, Ohio Valley General Hospital, Wheeling, W. Va.

Role of the Doctor

By Morris Nicholson, M.D.
Anaesthesiologist
Lahey Clinic, Boston

● The role of the doctor in the operating room should be discussed from two entirely different points of view. We should consider first, the role of the surgeon as the leader of the surgical team and secondly, we should consider the role of the anesthesiologist.

There are many valid reasons for considering the surgeon as a team leader. His long, specialized training equips him to assume this needed leadership. Probably the most important reason why he should assume responsibility and leadership is that the patient has come to him for relief of his surgical disease. As a result of the history, physical examination, and special studies which the surgeon has instituted he has recommended corrective surgical therapy. Once this decision has been made, a serious responsibility must be assumed by the surgeon which makes him view the patient and anything that happens to him differently than might the anesthesiologist, pathologist, radiologist, or operating room nurse or supervisor.

The surgeon can and should do a great many things in order to encourage others to share this patient-doctor

responsibility with him. He must remain a dignified and stimulating leader ready to give wise and considered counsel whenever needed by other members of his team, the operating room supervisor, or the orderly. He must help to plan routines in advance for all procedures that can be so planned in order to facilitate the smooth flow of daily work. Unusual, new, or complicated operations should be carefully studied and discussed with the operating room personnel if misunderstanding, lack of essential equipment, etc., are to be circumvented at the operation time. More efficient service is possible in the operating room if the surgeon forewarns the staff of his needs. This is particularly true when a request is made for an emergency operation.

It is possible for our ideal surgeon to do all the abovementioned things and still fail to reach the goal he strives for at each operation. What should he do under these circumstances? Much will and can be accomplished, if legitimate complaints or suggestions are discussed in a calm and objective manner with the operating room supervisor. Such matters must be taken up with the supervisor, for she, and she only, has the responsibility for investigating and correcting such faults as they arise in her department. However, not all legitimate complaints are brought to her attention; therefore they are seldom investigated or remedied and are constantly recurring.

Another sure way to improve efficiency and enthusiasm is by replacing the time-honored, destructive criticisms, so overworked by all of us, with a few congratulatory remarks on a job well done. A little praise, properly supplied, will do more to increase efficiency and build up a smoothly functioning unit than anything else the doctor (surgeon or anesthesiologist) can possibly contribute.

What is the anesthesiologist's role in the operating room? His role has changed a great deal in the last few years. One of the most progressive steps was taken by the United States Army when they specified in their Tables of Organization that the anesthesiologists be given the responsibility for running the operating room. This new development brought a large number of doctors in contact for the first time with the anesthesiologist who either knew how to fulfill this function or was making an honest effort to learn. The surgeon found he could do better work if he delegated responsibility for fluid therapy, blood replacement, immediate postoperative care to the anesthesiologist. The surgeon was able to concentrate his attention on the operation. The gradual assumption of responsibility by various members of the surgical team has been a great step in increasing efficiency and reducing tension.

Since this new role has gradually evolved for the anesthesiologist, what type of person do we need for this job? I believe he should be a quiet, intelligent doctor, well trained in his specialty, who likes to work with other people. He must be able to assume responsibility and be able to step into an emergency with calmness and authority and make quick and accurate decisions that will instill confidence in the rest of the surgical team. There is no place in anesthesiology for the panicky person who fears an emergency or who, when confronted with difficult problems, shows his lack of confidence by a loss of composure that rapidly infects all with whom he comes in contact.

In addition, the anesthesiologist from his vantage point can act as a liaison officer between surgical staff, operating room personnel, and administration. He should be able

and ready to discuss problems as they arise with surgeons, operating room supervisors, and members of the administrative staff. While acting in this capacity, it is essential that he be unbiased and able to analyze the entire situation so as to insure the best care at the least cost for the patient.

The anesthesiologist can render valuable service as a member of an operating room committee. In this capacity he should be able to bring his daily experiences to bear on matters of purchasing instruments, lights, tables, etc. As a member of such a committee he should be able to make suggestions regarding work simplification, the elimination of costly items, or the substitution of less costly ones whenever they are available.

Above all, the anesthesiologist must be enthusiastic about his work and try literally to infect others with this enthusiasm. This is a large order, but it can be filled if he remains self-critical, admits his mistakes, and makes an honest effort to learn by his own experiences and from the experiences of others. Finally, he must ever be willing and ready to impart some of this accumulated knowledge to others.

Art of Administration

● What is the operating room supervisor? What does she do for a living?

First she must be a coordinator. There are two main jobs of coordination, one involving things and the other people. These are closely intertwined. She must be certain that supplies and equipment are kept at proper levels, are prepared properly for each operation, and are adequately sterilized. This is highly specialized work. She must handle assignments of personnel to their various duties, and in so doing, she has to know the capabilities of all the people in her department.

In our hospital, you will find that we run along with a fairly stable group of people, and then an epidemic of marriage breaks out, and we lose half of our force within a month or so. We must start again with new people, find out their strong and their weak points, and where they can be best fitted into the team. That is an art.

The operating room supervisor must often arrange the operating room schedule. I hope that if nothing else comes from your deliberations during this session, you will discover the ideal method of working out an operating room schedule. I have seen it prepared in the operating room, worked out by the anesthesia department and by the admitting office. But, so far as I know, there isn't a perfect way.

The supervisor must cater to a large number of surgeons and do so without favoritism, an extremely difficult thing to do. It is the same situation encountered in hospital administration, where one deals with many people with somewhat divergent interests. How to be as pleasant

to the curmudgeon as we are to the nice, calm, easy-going person is a constant challenge.

The operating room supervisor must watch first, last, and always for the welfare of her patients. She must always be mindful that while in the operating room, the patient's most fundamental life-preserving processes are entrusted to our care in such a manner as is not true anywhere else in the hospital.

The supervisor must be always alert to new trends and developments and bring to administration means of improving service. She must be always thinking ahead and planning for such emergencies as major disasters without or within the hospital.

She must know more than many of her fellows some details of plant operation, such as laundry and steam and electricity.

She must be a combination of planner, first-sergeant, and chaplain.

What then, should the administrator expect from the operating room supervisor?

The administrator should expect a supervisor trained in the art of supervision and skilled in the direction of many persons of diverse backgrounds toward a desired end. Some of these persons will be directly under her command; others must never know she is ruling them.

The administrator should expect a supervisor skilled in many mechanical details of highly complex operations wherein a single break in technic would be disastrous.

He should expect a planner who looks to the future and prepares ahead for emergencies, as well as for routine needs.

He should expect an administrator whose department

By T. Stewart Hamilton, M.D.
Director
Newton-Wellesley Hospital, Boston

runs smoothly enough that justified complaints are minimal. I emphasize the word "justified." In other words, in looking for a supervisor, I wouldn't expect to find anyone with any more attributes than might be found in a combination of a genius and a saint. It is really amazing that we have so many of them!

What should the operating room supervisor expect of hospital administration and the administrator?

She should expect authority in her department and well-established lines of communication to her director of nursing, or if need be, to her administrator.

She should expect loyal cooperation. Cooperation from her personnel is mostly her responsibility, whereas from the doctors it is about 50-50. Cooperation from her administrator is our responsibility, and I hope that those of us who are in the field discharge our part of it.

She should expect an attentive ear when she needs it and not in 10 days or so. When a crisis occurs it doesn't do any good to call for help, and have someone say, "Oh, yes, see me a week from Tuesday at 3:15." She should expect the administrator to do something. And, if she comes down to him with an idea or a suggestion or something that needs action, she should go away with a decision or with the knowledge that a decision will come in short order. She should expect a decision which is decisive, and not one of the "we will see" type wherein the administrator is obviously hoping that the whole thing will blow over.

It is so easy for us in administration to wait and see if time won't do a good deal. It is extremely difficult to make decisions, and I hope that having written this, I shall be able to make a few more than I have in the past.

We experienced a good deal of difficulty in our hospital in getting the proper instruments. We would guess how much we needed in the budget, and then the purchasing agent would get out her stethoscope and listen for the squeaky wheels, and try to keep them greased. It wasn't working very well. We didn't have nearly enough money to buy all the instruments and equipment we needed.

In desperation, we formed one more committee. This started out as the Surgical Technic and Instrument Committee and consisted of representatives of the three major services. There were three or four doctors, the purchasing agent, the operating room supervisor, and a member from anesthesia. The Committee was so successful that it became obvious within a few months that we were going to give it something more to do. We changed the title to "Surgical Technics and Operating Committee." The group meets monthly, and does most of the things that have to be done, in running the operating room. It also advises with regard to the purchasing of instruments. The instruments are better and more useful and we find fewer of them end up within two months of purchase down in the storeroom, never to be used again. This committee has been extremely successful. Its duties have been extended, even to some of the problems that I am sure do not trouble anyone but us, such as people who like to start their operations 15 or 30 minutes after schedule.

The second thought is that of work simplification. We had an officer of one of the industries in Boston as a patient in our hospital. After he left he wrote on the routine comment sheet that as a man who was interested in work simplification, he was extremely interested in some of the things that happened in the hospital.

Our assistant director, who handled comment sheets, went to see him, and as a result, he and our personnel officer took the company's course in work simplification.

They were so enthused that we talked to the board. We received an appropriation, and went into the program, rather lifting ourselves up by our bootstraps. So far, in a year's trial, we believe that we are beginning to prove that such an undertaking is worthwhile for a hospital. A movie was made and if you were to look at the way some of the things were done before the work was simplified, you would say it couldn't be. When you see the results, you wonder why no one thought of the improvement before.

Factors in Purchasing Supplies for the O. R.

By A. H. Matthewson

Purchasing Agent

Massachusetts General Hospital, Boston

● What does this purchasing for hospitals amount to? It might be defined as obtaining the right amount of merchandise, in the proper quantity, at the right time, and at the right price. Maybe you noticed that I put price last of all, because in a hospital it is most important that the goods which you must have to operate and to take care of patients must be there at the surgeon's or the nurse's hands at the time they are needed.

Purchasing can be very small or quite a problem. For instance, at the Massachusetts General Hospital purchasing amounts to about two million dollars and that figures down on a working day basis to about $8,000, and on a weekly basis it amounts to around 300 purchase orders. Sometimes, in small and large hospitals each department makes its own contacts, buys its own needs, keeps them in its own closet, approves its own invoices and maintains its own little kingdom. The standard and, I believe, just argument, for centralized purchasing is something like this:

First of all, centralized purchasing insures a responsibility for specifications and supplies, that the proper merchandise is purchased, and that it is there when it is needed. Centralized purchasing also insures adequate sources of supply. Centralized purchasing cannot exist except through a spirit of cooperation. The purchasing department is a service department. It has no right to dictate—only to advise and suggest. The standards which are set up are not done so by the purchasing department, but by

committees who agree, through use, tests, etc., as to what type of items are best suited for each of the thousands of different uses in a large institution.

Centralized purchasing should also relieve the department heads of worry and responsibility. Department heads have enough to do in running their own departments, without worrying about where to buy, when to buy, and how to buy.

A centralized purchasing office should set standards, as I mentioned, and it should result in economies through volume purchasing. Cases may be purchased cheaper than dozen lots, and carloads are cheaper than truck loads. Frequently, when departments combine their needs for a year's time, carloads or even portions of boat loads of merchandise can be purchased.

Centralized purchasing should also simplify accounting from the time the goods are received, examined, checked in, stored, and issued. Invoices need not be approved by the ordering department; the purchase order and receiving slips are matched up with the invoice and saved for a month, and one check is drawn to one firm for one month's business, which may be ten orders or more. Promptness in accounting technics also saves cash discounts. The purchasing policies are generally determined by the Board of Trustees. They decide how much authority the department shall have. They give the purchasing agent the legal right to make contracts that may involve hundreds of thousands of dollars during a year's time.

The purchasing department is given the right to select the vendor, to determine quantities to purchase, to supervise the receiving, to store and issue all merchandise, to alter or reject specifications, to make requisition or requests for purchase which are not in line with the standards set up, or to change quantities because of market or price trends.

The purchasing agent is asked to serve on committees —such as the Standards Committee—to decide changes in stock items, Nursing Procedure Committees, Dietary, Housekeeping, Stores, Pharmacy, and others. He is expected to join purchasing associations, local, state and national, to take part in the Committee work for the AHA and to spread the knowledge of how this hospital buying business works.

Let us discuss sources of supply for a few minutes. Sources of supply can be local dealers, manufacturers, or wholesalers. The sources of supply are gathered together and they form a valuable reference file, including catalogs, salesmen's cards, purchase order files—by commodity, by department, or by project. Sources of supply include trade journals, such as the New York Journal of Commerce, the Modern Hospital, Hospitals, HOSPITAL TOPICS, and other magazines as well as the Thomas Registry which contains the names of every company in the country that manufactures the various commodities we use.

To decide which vendor to use is sometimes a little difficult. I would say that the most important factor is the dealer's dependability. If he cannot or does not keep his word about delivery, price, or quality of merchandise, he should be crossed off your list.

Geographical location is important. A nearby source of supply is useful in case of bad weather or a strike. It is just the old story: Don't put all of your eggs in one basket; get several strong baskets and put eggs in each!

The purchasing department maintains sources of supply and places orders. Orders can be of two kinds. Most hospitals have storerooms containing several thousand items. We have about 2,000 in ours. This merchandise is supposed to be kept in stock constantly, so that the departments can requisition, in small quantities as needed, for standard items described in the catalogs. Those stocks should be routinely maintained by the Purchasing Department in conjunction with the storekeeper.

Consider the special purchase requisitions. A special purchase is anything which isn't in the storeroom. These are kept to a minimum. In larger institutions the need for anything that costs over $25 or $50 is generally forecast in the annual list of requirements made up by each department prior to budget time. That list goes to the purchasing department and is priced. When the budget is approved, all special purchases that have been authorized are sent to the department, and as the need for them develops in the fiscal year, or as the time arrives when the purchase of those special items can be made best, they are purchased.

In this matter of operating room technic, as an example of how the purchasing department can benefit, I would mention the testing of new products, the developing of new types of sponges or abdominal pads. Several of the large dressings manufacturers, for example, work constantly with hospitals in the development of new products which will do a job better and at a cheaper cost to the hospital. For example, if you are asked to try out a 3 x 3 sponge instead of a 4 x 4, by using your persuasive powers to get the surgeons to try them for a length of time to determine whether or not the smaller sponge will do the job, you can do your bit to help the hospital in cutting expenses.

Every time we buy, we gamble. It is always hard to tell whether to stock up or go along with a low inventory. That is one of the things which make purchasing agents get grey-haired at a tender age. For example, just before the last war, the Massachusetts General Hospital spent several hundred thousand dollars beyond the normal needs for maintenance supplies, textiles, gauze, bandages, rubber goods, instruments, because it seemed costs must go up with the Korean situation going on as it did. But, if the war had been suddenly called off, and if the prices had suddenly dropped when the war scare terminated, the hospital would have suffered because of the transaction.

Perhaps something about the running of a large storeroom would be of interest. A storeroom has the responsibility for receiving goods, examining them for quantity and quality, storing them against the loss, filling requisitions, taking them to the department where they are to be used, keeping inventory records, and replacing stock, by requisitioning to the purchasing department. An experienced storekeeper, through controlling his maximum and minimum quantities on each item, can safeguard the hospital from running short and can reduce materially the amount of money tied up. By maintaining inventory at the proper balance between the quantity used per month, the length of time it takes for it to come from the factory, the possibility of the price going up or going down, a well run storeroom can, in a year's time, save a great deal of money for the hospital. There should be time, before purchasing items, to compare and examine, test and inspect.

We have been testing trays for about two years now. We have used plastics of various kinds, fiber glass, alumi-

num, and—right now—the latest thing is a Swiss cafeteria tray. It is lighter than aluminum, stronger than stainless steel, and it has a special surface on it that is harder than many jewels; it has a non-skid feature and it is very light. But it is very expensive. The ideal cafeteria tray has not yet been found. We are still struggling to get one.

Sometimes small hospitals, and also large ones, can benefit by buying through the various cooperative agencies. Possibly, the best known is the Hospital Bureau of Standards and Supplies, Inc., in New York City. It has been operating now for 46 years, and has over 200 member hospitals, coast-to-coast. It is a non-profit corporation, owned by the members, and has approximately 75 contracts which the member hospitals may or may not use, as they see fit. Dividends or patronage refunds are paid in proportion to the usage made by each member. Such cooperatives are a good balance, a good measuring stick, to compare with local prices. During the past year a Boston buying agency has been started called Hospital Purchasing Agency; 10 of the larger hospitals were the first members, and it is just getting along. It should turn out to be a means of saving money for its membership.

Let me tell you something about the layout of a purchasing department and how it operates: The ideal purchasing department should be on the main floor, near a public entrance, so that the salesmen can get to it without taking up the time of the information clerks. The purchasing department should also be near the storeroom, and it should be large enough to give the salesmen the courtesy of a private interview. There should be a waiting room with magazines, tables, and ash trays so that the salesmen can be fairly comfortable and rest their feet while waiting to see the buyers.

I think that a plug should be put in here regarding the value of the salesman to the buyer. Salesmen are specialists in just one or two things and they know or should know all about them, and those who go to the larger hospitals are tops in their line. They know all about their special item or items, the world situation, the prospects of improvement in the product, the chances of increases or decreases in price, the possibility of job lots or bargains that may be available. By treating the salesman as a human being who is trying to help the buyer in a spirit of mutual understanding and trust, a spirit can be built up which is most valuable. Then, when the price is going up, the salesman comes to his friendly buyer first or, if things are getting scarce, that buyer has the first chance to stock up; or, if there is special excess stock being sold, he, the friendly buyer, has the first chance to buy all or what part of it he wants.

What I would like to leave with you is the point which I have made before: purchasing departments are service departments; they are there to assist the department heads, to help them to keep the department out of trouble through adequate stock and the proper quality merchandise.

ED. Note:

The papers by Dr. Nicholson, Dr. Hamilton, and Mr. Matthewson were given at the institute on operating room administration and nursing, held by the Massachusetts Organization of Operating Room Nurses, in November, 1952.

Large-Scale Syringe Washer

● Manual cleaning for syringes is negated for three reasons: many injectable substances are compounded in oil or stearate bases and are virtually impossible to remove by manual means of washing and mechanical cleaning; workers are prone to develop severe dermatitis from contact with residual drugs, and transmission of virus-borne disease from syringes containing contaminated blood.

To eliminate these hazards and to facilitate cleaning large numbers of syringes, many hospitals have installed a Char-Lab. This device washes about 200 syringes in 20 minutes and requires the time of ¼ person for operation.

The manufacturers* of Char-Lab are now marketing a glassware washer of increased capacity. An estimated amount of 600 to 700 syringes can be processed at one interval.

Syringes are placed in glassware baskets which are fastened to a revolving drum. In the process the drum carries the baskets down into the washing solution and out again at the rate of nine revolutions a minute. This is followed by a final rinse which leaves syringes thoroughly clean.

Above: A typical load of laboratory glassware which can be washed in the new unit in an hour's time. The young lady points out baskets used to pack syringes for washing.

Although some hospitals may consider the initial cost of such equipment high, its purchase is justified by the amount of manual labor eliminated.

**Fisher Scientific Co., 717 Forbes St., Pittsburgh, Pa.*

A progress report: OPERATING ROOM MANAGEMENT

● Nurses have joined forces with engineers in Pittsburgh, Pa., to study ways of improving routine hospital methods and practices so that maximum use of professional nurse power available can be provided for patient care.

The project is designed to give hospitals the advantage of knowledge developed for American industries in recent years to save time and money and increase production through better ways of doing things and more effective use of equipment. Although underway only a few months, it is showing results which indicate at least a partial answer to some of the problems arising from the critical national shortage of nurses.

So far, the study and recommendations have been confined to operating room procedures in two hospitals of the University of Pittsburgh Medical Center. Definite time and money savings have been shown by new or modified methods in scheduling, linen packs, instrument care, syringe care, and glove care. Other areas under study include laundry care, linen care, stock control, and stock handling.

Hundreds of feet of motion pictures taken in the hospitals and used in the study indicate a variety of methods now used and a variety of equipment which could be standardized profitably. It also became apparent to methods consultants that additional attention should be given to the proper use of existing equipment, with an eye toward efficient and effective operation.

In the equipment field, the installation of machines to automatically wash, dry, and powder gloves greatly improved the time and efficiency factors of this detail in one hospital. The investigators are now looking for an automatic glove tester to further this improvement. In another operating room, a pressure washer sterilizer was recommended to step up the handling of instruments.

In other instances, results were obtained merely by reorganizing placement, handling, and step-saving procedures without drastic change in equipment or personnel.

Those closest to the program say only the surface has been scratched in any of the studies of operating procedures. They feel that the scope of the project, as determined by the Planning and Steering Committees, can be enlarged to materially multiply the man-hour and dollar savings possible in many other hospital functions.

The Hospital Scientific Management Project, as it is formally known, developed as a result of the Work Simplification Conference for Nursing held at the University of Connecticut for two weeks during July, 1952. The conference, and subsequent project, were brought about as the result of discussions by Dr. Lillian M. Gilbreth, president of Gilbreth Inc. and noted for her life-long work in time and motion methods and scientific management; Prof. Harold Smalley, University of Connecticut, and Dean Ruth P. Kuehn, University of Pittsburgh School of Nursing.

Objectives of the HSM Project are:

"The essential function of any hospital is to provide the best services and facilities for treating the patient swiftly and effectively and for making his stay in the hospital as pleasant and comfortable as possible. The objective of this project is to aid cooperating hospitals in performing that function by installing management technics that will enable the hospital staff to perform their duties more easily and more quickly. Thus, doctors and patients alike will obtain better and more economical service. Specifically, the aim is to find a total or partial solution to the existing shortage of professional personnel and to improve hospital methods."

To further the project, Dean Kuehn enlisted the aid of dozens of interested persons in the various schools of the University of Pittsburgh, the Medical Center of the University, the Hospital Scientific Management Conference and the Pittsburgh Chapter of the Society for the Advancement of Management. Schools of the University participating include Engineering, Business Administration, Pharmacy, Medicine and Nursing, and the Graduate School of Public Health.

Another interesting by-product of the Connecticut Conference is that the School of Engineering established a course in motion and time studies for Nursing Service Administrators.

Prof. Mary Edna Williams, chairman of the department of surgical nursing in the University, approached industry and secured interest in developing a new program based on redesign of patterns of management education. Another enthusiast who has devoted much time and effort to the project is Edna Prickett, assistant professor of surgical nursing in the University.

Among Pittsburghers approached concerning the Hospital Scientific Management Project was Harold B. Maynard, President of Methods Engineering Council and internationally known as the originator of methods-time measurement and developer of scientific management technics. Mr. Maynard offered the services of consultants in his organization to make necessary studies. Late in 1952, Warren L. Ganong, John Jarnmark, and John W. Punton of the Methods Engineering Council staff began the technical work which shows early possibilities of far-reaching results.

Summing the progress reports of the Hospital Scientific Management Project early in March, Dean Kuehn said:

"The initial results obtained from the studies of operating room procedures and use of equipment have convinced me that we are on the right track that will lead to improvements having far-reaching effects.

"Through the use of suggestions developed in the studies, I can visualize greater utilization of our nursing personnel for purely nursing duties by eliminating waste motion and time-consuming fringe activities. Since this can be proved in the operating rooms, where the utmost in efficiency naturally is to be expected, how much greater will be the savings in time and actual money when the principles involved are spread to other functions in a hospital.

"We have made an auspicious start toward fulfillment of the objective of this project and I want to express my thanks to every person who has contributed in any manner to the results thus far. I am enthusiastic about the future."

A REAPPRAISAL of Absorbable Glove Powder

An Article by

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● Several years ago, in association with Dr. E. P. Lehman, one of the present authors presented a report* (3) dealing with the dangers of talcum powder as a glove lubricant, and describing studies of a powder derived from corn starch as a suitable replacement for talcum. These findings were subsequently confirmed by other investigators, and a recent sample survey indicates that talcum has been replaced by the starch derivative powder in the operating rooms of 60 to 90 percent of the hospitals in the United States.

It has been well established that this starch derivative powder is vastly superior to and less hazardous than talcum powder. However, as is so often the case when a new therapeutic agent is developed, there is a tendency to lose sight of its limitations. When one hazard has been eliminated, whether partially or completely, it is easy to fall into the trap of assuming that the illusory "foolproof preparation" has been achieved and to throw caution to the winds. A widespread impression seems to have developed that starch powder is "perfectly safe." There has been a tendency to discard entirely the scrupulous effort to minimize powder contamination of the operative field, which was encouraged when talcum powder was in general use. A growing appreciation of this dangerous trend, together with a recognition of certain deficiencies in the earlier studies, has prompted experimental reappraisal of the effects of absorbable glove powder.

Evaluation of the effects of glove powder is based on several basic considerations from both the clinical and experimental standpoint.

1. The production by contaminating powder of adhesions on serosal surfaces or of granulomas in the soft tissues is the result of a foreign body reaction.

2. The production of adhesions and granulomas by contaminating talcum powder is the result of both chemical irritation and a foreign body reaction, although the latter clearly predominates. The fact that talc crystals are insoluble, and for practical purposes nonabsorbable, makes the reaction essentially an irreversible and permanent one.

3. Within limits, treated starch powder has been shown to produce a much less violent reaction than does talc. Provided all other factors conducive to inflammatory reac-

**See January, 1950 issue, page 42, also the O.R. Yearbook, Volume I, page 9.*

tion and adhesion or granuloma formation are excluded, starch powder appears to be completely absorbed and it leaves the serosal surfaces and soft tissues undamaged. But until absorption takes place, the starch granules constitute as much of a foreign body as would any other powder of comparable particulate size. The longer the granules remain unabsorbed, the more advanced the foreign body reaction will be, and the less chance there is that it will be reversible. When a complicating factor such as infection is added to the foreign body reaction of tissues, the process is much more violent and the extent of permanent scar tissue formation is proportionately increased. These facts have apparently been overlooked, and the oversight has led to an exaggerated confidence in the safety of treated starch as a glove powder.

PREVIOUS EXPERIMENTS

In our previous animal experiments, which demonstrated the superiority of treated starch over talcum powder, the interval between implantation of the test material and reexamination of the contaminated peritoneum was three weeks. It was shown that under ideal conditions, starch powder was absorbed without ill effect, as compared with dense adhesion and granuloma formation when talc was used, but no studies were included to evaluate the reaction to starch during the three-week interval. It is apparent that any absorbable foreign material, including the familiar surgical catgut, produces a tissue reaction before it is absorbed and that the severity and final effect of this reaction depends on a variety of factors.

It is not within the scope of the present discussion to review in detail the pathological physiology of the foreign body reaction. In spite of the extensive literature, really fundamental study of this subject is still in its infancy and conclusive information is very meager. E. P. Lehman, co-author of our previous publications on treated starch, has recently summarized (4) the information that is available regarding the reaction of living tissues to foreign materials. His thought-provoking appraisal of this complex problem should serve the double purpose of stimulating further study and of reaffirming the dangers inherent in the use of even the best absorbable materials in surgery. One paragraph of Lehman's discussion is particularly pertinent to the considerations to be presented here:

"It is clear that any discussion of the tolerance of tissue for foreign material must be based on the assumption that infection is absent. Gross infection is easy to recognize, but minor degrees of contamination by bacteria, promptly controlled without resulting gross infection, are not easy to measure in experimental studies. And yet, the minimal inflammatory reaction accompanying the destruction of undetermined bacterial contamination may modify the extent and the quality of the tissue reaction to the foreign material itself. It must be recognized in all studies of the foreign body reaction that this indeterminate factor may be present. With this reservation always in mind, let us try to define what is meant by tissue tolerance."

MULTIPLE VARIABLES

He goes on to list and to comment upon the multiple variables which influence the reaction of tissues to foreign

TABLE I.—SERIES 1 (28 DOGS)

Test material	Average number of adhesions			
	1-2 days	3-7 days	8-15 days	16-21 days
Starch+MgO (2%)	14[2]	12[2]	10[3]	4[4]
Starch+$MgCO_3$ (3%)	9[2]	11[3]	5[3]	4[6]
Control (No powder)	—	—	—	2[3]

The small figure in the upper right corner indicates the number of dogs from which the average adhesion count was obtained.

material. These include: (1) the size and nature of the wound; (2) the amount or particulate size of the foreign material; (3) the wetability of the material; (4) the physical quality and behavior of the material, including electric potential, crystalline structure, piezoelectric qualities, and radioactivity; (5) chemical characteristics of both the material and the host, including soluble and insoluble impurities, formation of secondary substances by the interaction of the material with the serum or interstitial fluid of the host, cytotoxic effects, hydrogen ion concentration, tissue enzymes, and protein reactions; (6) variations in the host, such as specific responses of a given type of tissue, or differences in the host as a complete organism (Thus the response may vary in the same individual under different conditions of health and disease, or individual and species differences may be pronounced); (7) antigen-antibody reactions.

Even this brief recapitulation of the factors to be considered in estimating the effect of a glove powder in tissue should be sufficient to indicate the caution with which any such powder should be used. Little fundamental information is available about the reaction of tissues to starch, either treated or untreated.

In this connection, and at the risk of free quotation to the point of plagiarism, another of Lehman's comments is important. He says: "The traditional empirical method of testing materials for surgical use in the tissues of animals and man is not profitable from the fundamental point of view. It remains necessary, however, in this era of heretofore unknown chemical compounds. Until prediction is possible, every new compound with possible surgical usefulness must be tested empirically, (though) it is a wasteful and uncertain method."

In common with our own and other previously reported studies, the work here presented is of an empirical nature and subject to the limitations inherent to that approach. Moreover, it does not provide answers to a number of questions which might be sought on an empirical basis. It is believed, however, that convincing evidence is afforded in support of the conclusions which follow, the application of which to surgical practice seems important.

The starch powder now in general use consists (1) of "a biologically absorbable powder prepared from corn starch by etherification with epichlorohydrin. The starch polymer chains are persumably cross-linked by 1, 3, diether glycerin groups to the extent of not more than two percent of the original starch weight. The starch derivative powder is mixed with two percent magnesium oxide, and contains small residual amounts of sodium sulfate and sodium chloride."

Various investigators, including ourselves, have dem-

onstrated the complete absorbability of this preparation in living tissue. The "tanning" process with epichlorohydrin renders the starch granules resistant to autoclaving but cannot be shown to affect either the tissue tolerance or the absorbability of the starch, as long as it is well dispersed in fine particles. It is obvious that "clumps" or masses of this or of any other powder imbedded in tissue will produce more reaction and absorb more slowly. It is desirable, therefore, from the standpoint of both lubricating qualities and tissue tolerance, to keep the powder as finely dispersed as possible. In the original development of the experimental powder (2) 10 or 12 different dispersal agents were tested. For various reasons, only magnesium oxide and magnesium carbonate were found to be acceptable. In the commercial preparation, as noted above, magnesium oxide in two percent concentration is added as a dispersal agent. Although our previous studies indicated that this addition, in the concentration used, was harmless to tissues, some question was raised about it. Seelig believed, on the basis of tests for aldehyde with Schiff's reagent, that paraldehyde had been used in the tanning process. Postlethwait and his associates (7) demonstrated that the faintly positive reaction with Schiff's reagent was due to the presence of magnesium hydroxide, derived in solution from the magnesium oxide dispersal agent. Further chemical studies by Davis and George showed that after prolonged storage, appreciable amounts of the magnesium oxide are converted to magnesium carbonate. It seems possible, therefore, that a more stable glove powder might result from the initial use of magnesium carbonate as the dispersal agent. This was one of the two agents found to be acceptable in the original studies, although to be effective, a three percent concentration must be used, as compared with two percent of magnesium oxide.

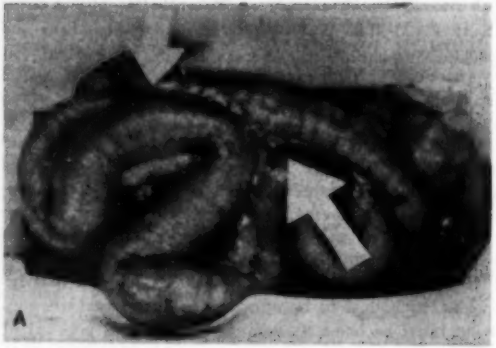
COMPARISON STUDIES

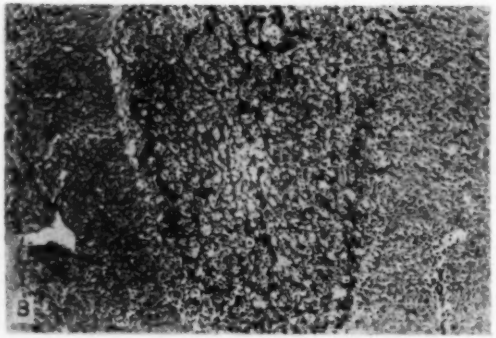
One purpose, then, of the present study has been to compare, under standard conditions, the relative tissue

TABLE II.—SERIES II (66 DOGS)

Interval from implantation until adhesion count, days	Starch with MgO			Starch with $MgCO_3$			Control—No powder		
	Greatest No. of adhesions	Smallest No. of adhesions	Average No. of adhesions	Greatest No. of adhesions	Smallest No. of adhesions	Average No. of adhesions	Greatest No. of adhesions	Smallest No. of adhesions	Average No. of adhesions
2	22	5	10.5 [9]	19	4	13.8 [6]	0	0	0 [2]
18	34	0	9.9 [14]	22	0	10.7 [13]	1	0	.33 [3]
25	10	2	5.1 [7]	13	0	6.2 [8]	5	1	2.2 [4]

The small figure in the upper right corner indicates the number of dogs from which the average adhesion count was obtained.





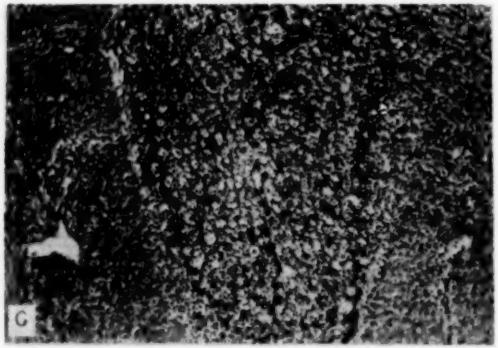


Fig. 1. Dog 877. Starch powder with two percent magnesium oxide —24 hours. a, Gross appearance of the bowel. The serosa is dull and lusterless, as it appeared immediately after dusting. Adhesion count—14. b, Section through an adhesion as seen under ordinary illumination. ×75. c, The same field as that shown in b, with partial rotation of the polarizing discs. The adhesion is seen to consist of acute inflammatory exudate interspersed in which are numerous starch granules.

tolerance toward two identical starch powders in which magnesium oxide and magnesium carbonate, respectively, have been added as dispersal agents.

Another question to which an answer has been sought is the degree and extent of peritoneal reaction which takes place during the interval of six to 25 days prior to complete absorption of the powder. This question has already been studied to a limited extent in both dogs and rabbits by Postlethwait and his associates. They found that the rate of absorption of the powder varied considerably, from as little as 24 hours to as much as 12 days. Their study illustrates the very marked species and individual variation in tissue reaction to foreign bodies and in adhesion formation. The great difference among individuals, in their tendency to form adhesions and in their ability to absorb them, is familiar to all clinical surgeons, and it is one of the variables mentioned by Lehman as contributing so much to the inaccuracy of empirical experimental studies. It was felt that if tests were made on a larger series of animals, statistically significant comparisons might be achieved.

It was believed that the study might produce evidence to emphasize the fact that in spite of the demonstrated superiority of treated starch over talcum powder as a glove lubricant, due precautions should nevertheless be taken to minimize contamination of any wound with starch powder, since no foreign material, even if it is ultimately absorbable, is entirely innocuous.

METHOD

The basic procedure of the present study is essentially the same as that previously employed. Dogs were used in all the experiments because it is believed that the reaction of the canine peritoneum more nearly approximates that in the human patient than is the case with other experimental animals. The dog is large enough to permit a closer experimental parallel with conditions in a standard operation on a human patient. The experimental cycle consisted of laparotomy under careful aseptic conditions with delivery of the small bowel. In test animals, the entire small bowel and mesentery from the ligament of Treitz to the ileocecal valve was dusted as evenly as possible with a measured amount of test powder. No matter how carefully this was done, the distribution was uneven, with clumps of powder, obviously difficult to absorb, in some areas, and with finely dispersed particles in others. This fact is important and will be commented upon later. In control animals, the bowel was handled in an identical way but no powder was applied. In all operations, gloves were first carefully washed in running water.

After intervals ranging from one day to 25 days, the animals were either sacrificed or reoperated upon through a new incision on the opposite side of the abdomen, and the adhesions were counted, using the method of Lehman and Boys (5). As these authors have pointed out, this represents only "an exceedingly rough quantitative estimation of results," but to our knowledge it is the only method available for a quantitative comparison of the effects of various agents. To express these results in numerical terms is inaccurate to a degree, and exposes them to considerable misinterpretation. Bearing in mind the many variables emphasized by Lehman, the presence of 8 or 10 fine, tenuous adhesions in an otherwise clean and glistening peritoneum may actually indicate much less reaction

than four or five large sheet-like adhesions between mesentery and mesentery, bowel and bowel, or mesentery and bowel. Hence, too much emphasis should not be placed on the numerical results. We have, therefore, attempted to compensate for this obvious inaccuracy by illustrating the differences photographically. Nevertheless, the numerical count of adhesions in a large enough series of animals has some comparative statistical significance.

As a further check on the gross observations, representative adhesions were removed en bloc when present, and paraffin sections were prepared for microscopic examination under normal and polarized light. In the same animals, the lymph nodes at the root of the mesentery were also removed for similar study. It was hoped that the character and degree of inflammatory reaction might throw some light on the presence or absence of subclinical infection. Since intact starch granules are readily identified under polarized light (by the characteristic maltese cross), it was also hoped that the progress and mechanics of absorption might be followed. These efforts met with only very limited success.

PROCEDURE

In all of the present experiments on dogs, the test dose of powder was ½ teaspoonful. For reasons indicated in our previous report, a volumetric measure appeared to be preferable to a weighed dose, and in the earlier studies ½ teaspoonful of starch derivative powder was found to weigh approximately 1.0 gram. This is a large dose in the peritoneum of a dog and constitutes a much more severe test of the powder than would ever be likely to occur in clinical practice, even after perforation of a glove. It represents the rough equivalent of all the powder that can be washed from the surfaces of eight pairs of surgical gloves which have been prepared for routine use in the operating room.

In the course of this study, 100 dogs were operated upon. This large number of dogs taxed our kennel facilities severely and it was impossible to keep each animal long enough, before operation, to be sure that he was in good physical condition. Many dogs were operated upon the same day or the day after they were received from the dealer. As a result of this, 16 dogs died of distemper or of its complications, before the assigned day for their second operation and adhesion count. In three other dogs, the test was invalidated by obvious wound infection. In one dog, the proper identification of the test powder was questionable and this animal was, therefore, eliminated from the series. Thus 20 out of 100 animals were invalidated.

The remaining 80 dogs, whose wounds healed without gross evidence of infection and who were re-examined on schedule, still left much to be desired in terms of general physical condition. Virtually all of them were infested with worms, malnutrition was common, and many had been previously used in another series of experiments dealing with the healing of small burns of varying depths on the skin of the back. Thus a wide range of variables was introduced, which may explain why a few adhesions were produced even in the control dogs where no powder was applied to the peritoneal surfaces. It must be remembered, however, in terms of the application of the experimental results to clinical surgery, that ideal conditions are seldom achieved when the human peritoneum is exposed. In appendicitis, perforated ulcer, or intestinal

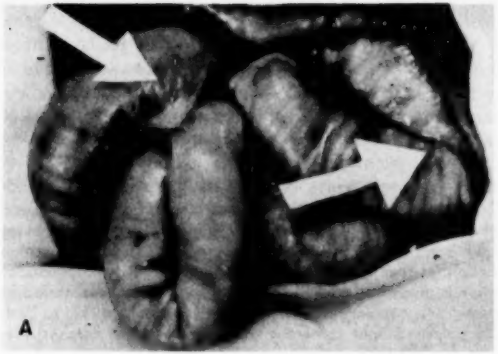
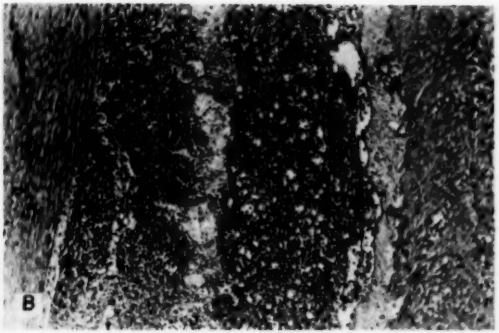
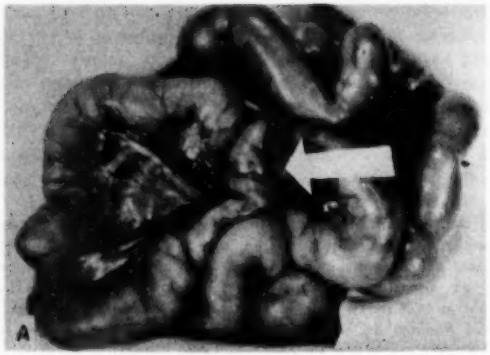


Fig. 2. Dog 34. Starch powder with three percent magnesium carbonate—24 hours. a, Gross appearance of the bowel, which is similar to that of the animal in Fig. 1. Adhesion count—21. b, Section through an adhesion, with ordinary illumination. ×75. c, The same field as that shown in b, with partial polarization of the light. ×75. The findings do not differ significantly from those shown in Fig. 1.





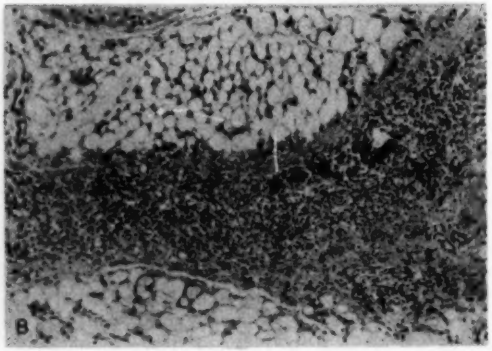
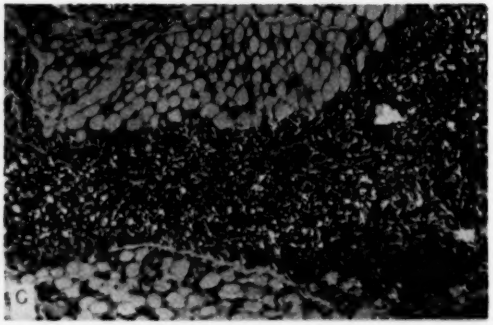


Fig. 3. Dog 43. Starch powder with two percent magnesium oxide —eight days. a, The bowel is clean and healthy looking except where there are adhesions. Adhesion count—12. b, Section through an adhesion, as seen under ordinary illumination. Polymorphonuclear infiltration is much less marked than it was in the 24 hour period but fibroblastic and capillary proliferation are evident. ×75. c, Under partially polarized light numerous starch granules are demonstrated. ×75.



resections of any kind, either bacterial or chemical contamination, or both, are present in varying degree. Where hemoperitoneum, either prior to or as a result of surgery is encountered, another variable is introduced. The relationship of the enzymes associated with malignancy to foreign body reaction is entirely unknown, so that in operations for human abdominal carcinoma, still another variable is present. Therefore, since the study was designed to simulate actual conditions in human clinical surgery, the fact that the dogs were not uniformly in perfect health did not seem necessarily undesirable.

RESULTS

Series 1. In the first series, a base line was sought by using a small series (28 dogs) of animals and by conducting the adhesion count at frequent intervals, ranging from one day to 21 days. It was hoped that by this means a rough estimate of tissue tolerance and rate of absorption of the powders could be obtained. It was not expected that this series would be statistically significant, but only that it would aid in determining at what intervals a larger series of animals might most profitably be studied. The results of this series of experiments are summarized in Table I.

No valid conclusion can be drawn from this series. In a few instances, where the interval between implantation and adhesion count coincided with the intervals in the first series, the same animal was included in the second series, since this increased the statistical sampling without vitiating the results in either series.

Series II. In the second series, 66 animals were evaluated. Of these, 17 were examined after two days, 30 after 18 days, and 19 after 25 days. The statistical results are summarized in Table II.

It is seen from this table, that even with a relatively large dose of powder, adhesion formation is not extensive, regardless of which dispersal agent is used. In comparison with talcum powder, as demonstrated in our own and other previous studies, the reaction is not severe, but there is nevertheless enough reaction to merit serious consideration and a conscientious effort to avoid it. The rather wide range in the number of adhesions reflects the introduction of variables such as subclinical infection, health of the animal, uneven application of test powder, and variations in the degree of trauma during operation, as outlined in the preliminary discussion.

It was pointed out previously that in an empirical, and therefore necessarily inaccurate study of this kind, with many uncontrolled variables, numerical comparison alone is likely to convey a distorted impression. In the accompanying illustrations, representative examples of the gross and microscopic results are presented which will help to clarify the interpretation.

Figures 1 and 2 indicate the typical appearance of the dog's bowel 24 hours after implantation of the test powders. The reaction is almost identical, regardless of which dispersal agent has been used with the starch powder. The serosal surface of the bowel is dull and lusterless, as it looks immediately after the powder is applied, but no adhesions have formed where the distribution of powder is even and where it has separated into individual granules. Adhesions did develop wherever clumps of powder had fallen. Here, under the microscope, a fresh fibrinopurulent exudate is seen with abundant polymorphonuclear

leucocytes. Under polarized light, the mass of starch granules is readily seen. The gross adhesion count appears to reflect the number of such clumps or aggregates of powder granules rather than a general inflammatory reaction such as is seen in bacterial peritonitis. Hence at this early stage, a foreign body reaction to aggregate masses of powder granules seems to dominate the picture, and the total adhesion count of 14 and 28 is not actually significant.

In Figures 3 and 4, the situation after eight days is shown. Polymorphonuclear cells are less numerous, fibroblastic proliferation is present, and foreign body giant cells have appeared. A developing granuloma is now evident and starch granules are still present in large numbers. Except in the areas where these clumps of powder have fallen, a healthy peritoneal sheen is apparent and the serosa looks normal. Thus, where the powder has been well distributed in individual particles, all reaction seems to have subsided. Whether or not the existing adhesions will absorb would then depend on how large a clump of powder produced each one of them and on the indeterminate factors of subclinical infection and other variables. There is no significant difference in the tissue response to the starch powder, regardless of which dispersal agent is used. The difference between eight and 12 adhesions is, therefore, of no experimental importance so far as the two powders are concerned.

The next two groups of photographs illustrate the findings in two dogs in which adhesions were still present after 18 days. In Figure 5 (dog 99), one adhesion remains, while in Figure 6 (dog 88) there were 34 adhesions. In cold figures, this would suggest a wide difference in the reaction to the two dispersal agents. In both dogs, the bowel is normal except where the residual adhesions are present. This suggests that the adhesions have occurred where clumps of powder fell. It is reasonable to suppose that most of the clumps were small in dog 99 and the resulting granulomas did not develop into irreversible fibrous scars. When the starch was digested and absorbed, the granulomas disappeared. However, where a large clump fell, even though the starch was absorbed, the process took so long that a fibrous adhesion has remained, which is likely to be permanent. No starch is seen under polarized light and this illustration is, therefore, omitted.

In dog 88, although 34 adhesions are present, their appearance, both grossly and microscopically, suggests that they are very close to complete absorption. A few starch granules remain but there is little or no fibrous proliferation, and when compared with the eight day dogs, it may be surmised that this dog's bowel would have been clean and free of adhesions in a few more days. The animal is actually much better off than the one who has only a single large adhesion of a permanent character. It is presumed that subclinical infection did not play a major part in the persistence of this single adhesion, because if this had been the case, it seems unlikely that the rest of the bowel could have returned so completely to normal. Thus the size of the clump of powder is believed to have been the determining factor.

Reference to Table II will show that dog 88, with his 34 adhesions, represented the animal with the greatest number of adhesions encountered after 18 days. The average number of adhesions in 27 dogs was 9.9, and most of the animals had no adhesions, as shown in Figure 7, a and b. Their bowel surfaces were usually as clean as

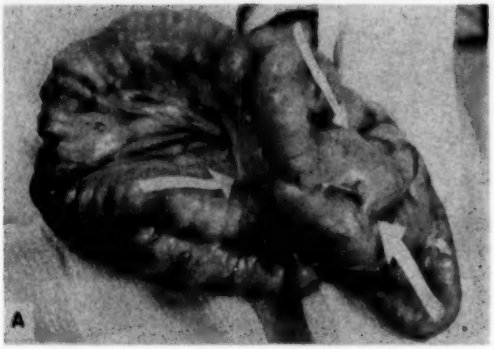
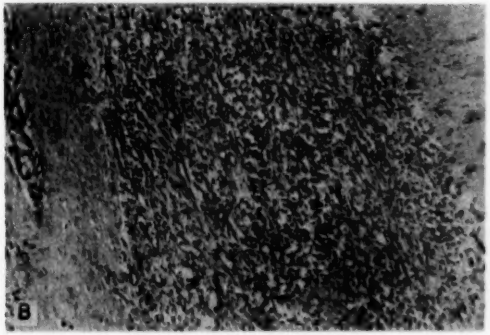
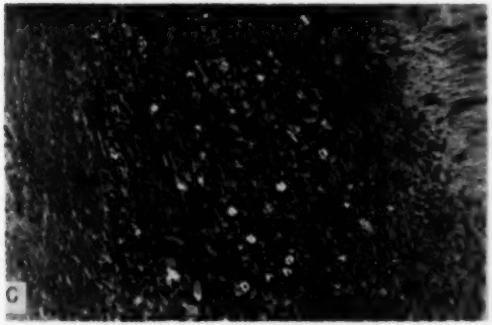


Fig. 4. Dog 55. Starch powder with three percent magnesium carbonate—eight days. a, Gross appearance of the bowel. The serosal surfaces appear normal except where clumps of powder have fallen. Adhesion count—eight. b, Under ordinary illumination the inflammatory process is similar to that seen in Fig. 3, except for the absence of foreign body giant cells. ×75. c, Under partially polarized light starch granules are abundantly present. The gross and microscopic findings are again essentially the same in both eight day dogs.





were those in the control animals (Fig. 7c). It may be concluded then that unless large powder clumps or masses are present, the adhesions initially formed are absorbed when the starch powder is absorbed, provided ideal conditions of atraumatic and aseptic handling exist.

If infection supervenes, the reaction will certainly be much more violent, and even though the starch, like surgical catgut, is ultimately absorbed, permanent scarring and unabsorbable adhesions may be expected. This situation is exemplified in Fig. 8. In this animal, a gross wound infection indicated that asepsis had not been achieved at the initial operation. Twelve days following implantation the entire bowel was fused in a mass of uncountable adhesions, and microscopic section showed not only the starch granules but also a persistently severe inflammatory reaction. This, of course, represents the result of gross bacterial contamination. Somewhere between this extreme and the complete absence of persistent reaction, shown in Fig. 7, will lie the effect of starch powder on a peritoneum in which subclinical infection is present. This is a phase of the problem which defies accurate analytical study.

When an interval of 25 days elasped between implantation and re-examination, the average adhesion count dropped appreciably, suggesting that some of the adhesions produced by powder aggregates were not irreversible and were still capable of absorption. This outcome would seem to depend on both the size of the clump and on the uncontrolled variables. Under average conditions, as long as it is well dispersed, the powder is well tolerated and quickly and harmlessly absorbed. At both 18 and 25 days, most of the animals showed no adhesions, and in those in which adhesions persisted, the surfaces were clean except

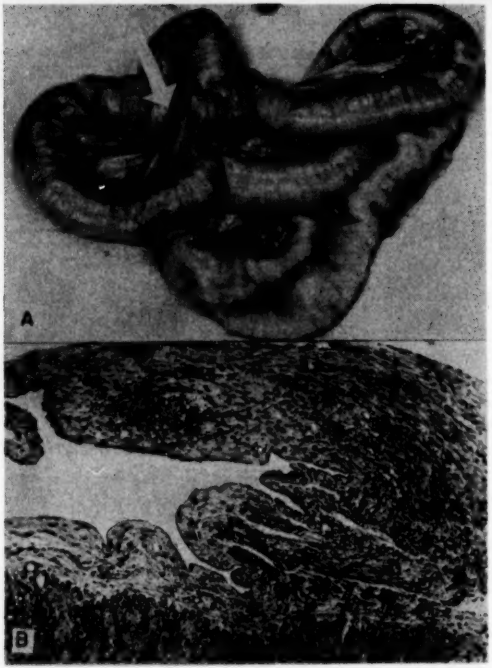


Fig. 5. Dog 99. Starch powder with two percent magnesium oxide —18 days. a, Gross appearance of the bowel. The serosal surfaces appear normal except for a single adhesion. b, Section through the adhesion. A firm fibrous scar is present. c, Under polarized light no starch was demonstrated and is, therefore, not illustrated. ×75.

where large clumps had fallen. That the powder alone could not be held entirely responsible is illustrated by the fact that in the control animals a few adhesions occurred.

Study of sections made from the mesenteric nodes of the test animals showed a complete absence of any starch granules. This fact tends to confirm the observation noted in our previous report that powder particles on the peritoneum are either absorbed or encapsulated where they fall and are not taken up by the lymphatics.

DISCUSSION

Talcum powder was not used in the present study because its use would have represented a repetition of our own previous experiments and those of many other investigators. It has been established that talcum powder, applied under the conditions of these experiments, consistently produced a violent reaction with uncountable dense adhesions. The present work is not designed to demonstrate the superior safety of starch powder as compared with talcum powder. The dangers attendant upon the use of talcum powder as a glove powder have been abundantly demonstrated by many competent studies and are beyond question. Starch derivative powder has been shown, on equally good evidence, to be much better tolerated and to be as nearly innocuous as it is possible for any sterilizable powder to be. No matter how benign a powder may be, and no matter how quickly it is absorbed, it is, for the duration of its presence in tissue, a foreign body.

The present study has sought to emphasize this important point. The evidence presented indicates that starch powder is well tolerated provided it is properly dispersed into individual granules. The need for a dispersal agent in any starch glove powder is apparent from the results here presented.

Although a review of the extensive literature on the subject would not be worth while here, it is important to remember that the "ideal" glove powder must meet a complex array of minimum requirements. Its physical qualities as a lubricant, its effect on the surgeon's hands, its effect on rubber gloves, and the tissue reaction when it contaminates a wound are all essential considerations. An absorbable, digestible, chemically inert powder such as starch was long recognized as approaching this ideal. The difficulty lay in achieving a sterilizable form of such a powder. The powder derived from polishing raw rice, for example, is finely divided and chemically benign and has been used for centuries in the Orient for cosmetic purposes. But it cannot be sterilized without loss of all its desirable properties as a glove lubricant. The same difficulty applied to other vegetable powders until a method could be found to harden or tan their individual whole granules in order to make them resistant to autoclaving. An early approach was to fix the granules with formalin, but this procedure immediately introduced a strong chemical which living tissue could not tolerate. The "tanning" process mentioned earlier accomplishes the desired result effectively in corn starch, but to assure further the adequate dispersal of the particles, a dispersal agent is added. There appears to be no significant difference, so far as tissue tolerance is concerned, between two percent magnesium oxide and three percent magnesium carbonate as dispersal agents.

The present study indicates that this dispersal into individual granules is essential to rapid absorption and to

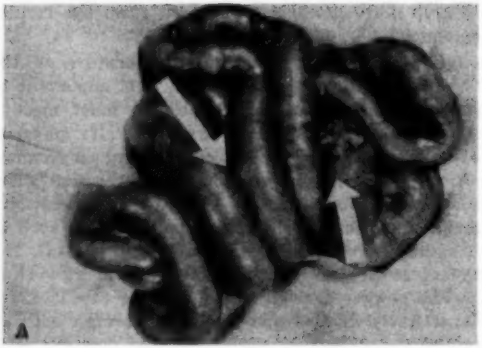
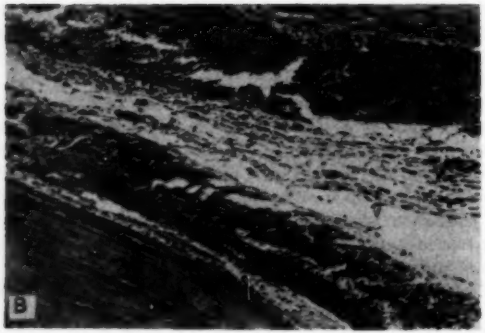
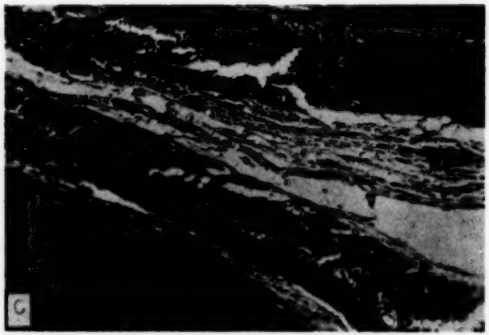


Fig. 6. Dog. 88. Starch powder with three percent magnesium carbonate—18 days. a, The bowel appears healthy except for multiple small friable adhesions. Adhesion count—34. b, Under ordinary illumination a section through one of these adhesions demonstrates its tenuous character. Only a few starch granules are shown (c) to remain when the light is partially polarized. It is believed that such adhesions would progress to complete absorption in a few more days. ×75.





minimum reaction in tissue. The starch powder used in these experiments is so finely dispersed after autoclaving, that a number of surgeons have complained that it clouds the air too much when they put their gloves on. In terms of tissue tolerance, this dispersal is highly desirable but it emphasizes one of the precautions which should be taken in using any powder lubricant for gloves.

Although the conditions of these experiments and the quantities of powder used represent a much more rigorous test than ordinarily would be encountered in clinical practice, the results are representative of what may occur when the powder is permitted to contaminate surgical wounds. Clumps of powder can gain access either from heavily powdered glove surfaces or when a glove is accidentally torn or punctured at the finger tips. It is obvious that in clinical practice the bowel would not be dusted heavily with powder as it was in these studies. The fact that the reaction is relatively slight, even under these conditions, is an indication of the desirable qualities of treated starch as a glove powder. More important, however, is the clear implication that this or any other powder is not foolproof. If it is carelessly used, especially in the presence of infection or any of the other variables which are consistently present in clinical surgery, it can produce adhesions which may not be absorbed.

The same precautions which were employed when talcum powder was in general use are still important when starch powder is used. The fact that starch powder is biologically "nonirritating" and absorbable, when finely dispersed, does not mean that the basic surgical principles of avoiding contamination of wounds with foreign material may be abandoned. Air contamination should be kept at a minimum and gloves should be thoroughly washed as free of powder as possible before the operation is begun. If a glove is torn or punctured, it should immediately be replaced and the fresh glove should be washed before the wearer returns to the surgical field.

This is not to say that starch powder is any less safe, in comparison with talcum or lycopodium powder, than the original studies indicated. We believe that treated starch comes as close to being an ideal glove powder as is theoretically possible. The point is that as long as powder is used as a glove lubricant (and its advantages over the old "wet technic" are obvious), due precaution should be taken to avoid contamination of the wound with the lubricating powder. The preventable hazards inherent in mineral or chemically irritating powders have been eliminated, but the principles of foreign body reaction remain and must be given due consideration.

CONCLUSIONS

1. Although treated starch powder is biologically absorbable in tissue, it produces a foreign body reaction as long as it is present.

2. The intensity, duration, and reversibility of the foreign body reaction produced by starch granules is influenced by many variables, of which some can be controlled and some cannot.

3. The complete dispersal of the powder into individual granules is essential and is one of the controllable variables. When adhesions are produced by starch powder, they appear to be the result of "clumps" or aggregate deposits which cannot be absorbed as rapidly as can the individual granules. The longer absorption is delayed,

(Continued on page 72)

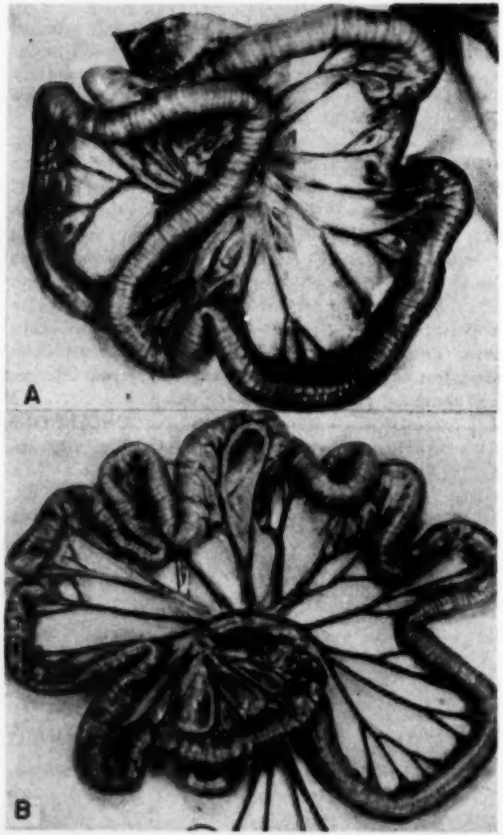
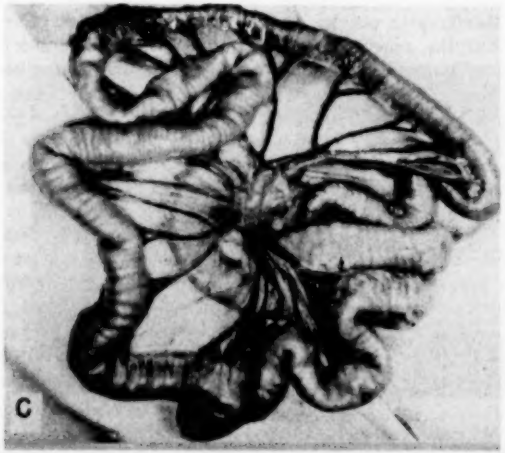


Fig. 7. a, Dog 319. Starch powder with two percent magnesium oxide—18 days. No adhesions. b, Dog 86. Starch powder with three percent magnesium carbonate—18 days. No adhesions. c, Dog 326. Control. No powder used. No adhesions. In general, if the powder was evenly distributed and no clumps or large aggregates were allowed to fall in any given area, absorption was complete in 18 days and no adhesions were formed.



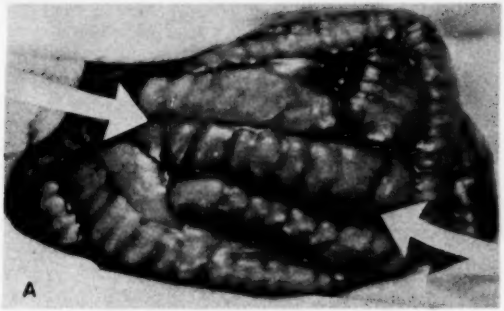
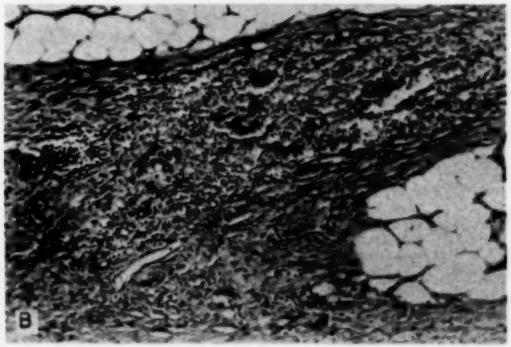
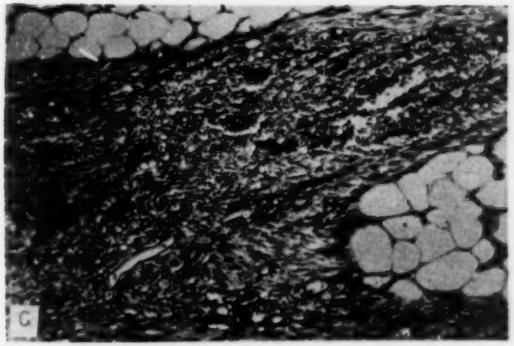


Fig. 8. Dog 77. Starch with three percent magnesium carbonate—12 days. A gross wound infection occurred and obvious bacterial peritonitis was present. The entire bowel is fused by adhesions in which a violent inflammatory reaction is seen microscopically. These findings, in the presence of infection, after 12 days, may be compared with those after eight and 18 days in which no demonstrable infection occurred. ×75.





the greater is the likelihood that the foreign body reaction will be irreversible and that the adhesions will be permanent. In the absence of infection and under ideal conditions, a large dose of starch powder appears to be relatively harmless to the peritoneum provided it is properly dispersed into individual particles which can be absorbed quickly.

4. There appears to be no difference in the tolerance of the peritoneum to treated starch powder, regardless of whether two percent magnesium oxide or three percent magnesium carbonate is used as a dispersal agent.

5. Sterilizable corn starch approaches the theoretical ideal as a powder lubricant for gloves. Nevertheless, any powder, no matter how benign it may be or how quickly it is absorbed, produces some degree of foreign body reaction when it contaminates an open wound.

6. Every possible precaution should be taken to prevent powder contamination of open wounds or serosal surfaces, and no powder is so "safe" that it can be carelessly used.

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Question Box

Each month questions pertaining to O.R. problems and technics will be answered by Dr. Carl W. Walter, nationally known for his operating room technic courses and as the author of "Aseptic Treatment of Wounds" (MacMillan). Questions should be addressed care of the O.R. Editor, Hospital Topics.

Q. How long should a room be closed after terminal disinfection following a case of colon bacillus or bacillus welchi?

A. I do not feel that an operating room has to be quarantined following a case of colon bacillus or bacillus welchi. Indeed, the room is probably safest immediately after use in that the organisms involved have not had opportunity to dry in the blood and pus left in the room. The important things to remember are that the instruments and linen must be disposed of to provide protection for the staff and the next patient. There is a technic for this described in Chapter 15 of my monograph, *Aseptic Treatment of Wounds*. Care must be taken to see that spots of blood and pus on the floor are immediately disinfected. Lime paste should be spread on the spots immediately they occur during the course of an operation. The lime paste is subsequently mopped up with the usual germicidal solution used in the mop pail. Any spots on the walls must, of course, be treated in the same manner. I do not feel it is necessary to give the walls any more attention than that which is included in the ordinary housekeeping schedule. I feel that care should be taken to disinfect the soles of the shoes of the staff working in that operating room.

Q. Do you feel it absolutely necessary to use a control to determine the sterility of the contents of a drum?

A. I think that the use of tell-tale controls in sterilization is a needless expense which can be avoided by intelligent operation of the sterilizer and good maintenance of that sterilizer. A predetermined sterilizing time based on the largest pack or the largest flask of solution to be sterilized should be adhered to. The sterilizer should be loaded to provide for free interchange of air and steam and a horizontal path for the escape of air from containers, etc. The sterilizer should be installed so that there is an adequate steam supply. Whenever possible, automatic locks and timing devices should be used. Lacking such equipment, personnel should be trained to operate the sterilizers honestly and with a single clock; wrist watches

should not be used. I think sterilizing drums are needlessly clumsy and noisy. They invite over-crowding and require a prolonged sterilizing time for adequate penetration. A four thickness muslin wrapper is a good bacterial barrier, allows quick penetration by steam and in the case of a large laparotomy pack, can serve as a sterile drape for the instrument table.

Question: Are you using the Char-Lab in place of the Instrument Washer Sterilizer?

Dr. Walter: No; this is a way of washing instruments free of blood and grease and so on, before you store them away. The instrument washer-sterilizer, such as is made by Castle or American or Scanlan-Morris is a way of taking blood and pus and grease and bacteria off instruments, and they are intended more or less for terminal sterilization, so that instruments are then safe to handle or sterile for another operation.

The Char-Lab is very convenient for cleaning instruments. You can put the instruments from a morning's work in, get them clean, using the right type of detergent. Follow the wash with a brightening process, if you wish. Then, you dry them and store them.

And, most instruments that get stiff aren't stiff because of anything except blood and pus, which get in the joints, bake on, and make the instruments stiff. This is no reflection on the person who wields the brush, because the brush can't get into the interstices. No one can dry the surfaces which are tightly opposed, manually. An instrument dryer is a "must" in every instrument room.

The other use for the instrument washer-sterilizer is rather an easy, quick way of sterilizing instruments, full of grease or not, pre-operatively.

You can take a whole kit of instruments and get them ready for use in about 12 minutes.

Question: If you fold-clip the end of cellophane tubing after sterilization, how do you keep the catheter from being contaminated?

Dr. Walter: You need not worry about that. You roll it up and you never open that end again; you remove the catheter from the other end.

Question: Do you open it with a pair of scissors or what?

Dr. Walter: You can fold them so that all of the surfaces which will be exposed, will be sterile. If you package the catheter so that the end normally held is present at the end which is closed prior to sterilization, you will always unwrap them at the sterile end. Take the clip off; unwrap it, and everything distal to that fold has been sterile on both sides.

Question: I think in the literature on that, they advocate folding both ends; but, we discovered it popped off in the autoclave.

Dr. Walter: That is right; somebody got a little too enthusiastic about it. It will pop off.

Question: There seems to be a solution; you put a Gem Clip on it, and that doesn't blow off.

Dr. Walter: But, my big problem in using it is to be sure the steam gets into it, to begin with. It doesn't take any longer to put the clip on afterwards, than before.

Question: But, you do claim the steam penetrates?

Dr. Walter: I don't claim the steam penetrates the tubing, no. I think it is essentially a dry heat sterilizer; therefore, you should have moisture inside to begin with.

Question: What you have said is that it is permeable to steam?

Dr. Walter: It is, but not at a rate useful for this purpose.

Q. Please state the correct way to sterilize VASELINE gauze.

A. Preparation of VASELINE gauze:

1. Cut gauze strips to desired length.
2. Arrange in shallow pan.
3. Sprinkle gauze with 2-3 cc. water.
4. Pour on melted VASELINE—amount should be limited to approximately one ounce of VASELINE and 10-12 strips, 2 or 3" gauze.
5. Sterilize in dry heat at 320°F. for one hour; or dry heat at 250°F. for four hours.

For larger quantities or larger sheets of VASELINE gauze, prepare as above, then expose to saturated steam at 250°F. for 30 minutes; turn off steam to chamber and expose to dry heat at 250°F. for four additional hours.

Q. How do you advise that we treat cystoscopes and ureteral catheters after they have been used on a known case of G. U. tuberculosis? Our method is to wash clean with a detergent such as Tide, rinse, immerse in a quaternary ammonium compound for 30 minutes. However, we have been told that quaternary ammonium compounds do not kill tubercle bacilli, regardless of length of immersion. What do you suggest?

A. Immediately after use, cystoscopes which can be soaked are dropped into a 1:1000 solution of calcium hypochlorite. This is made using a teaspoon of ordinary chlorinated lime to a liter of water. The cystoscope is washed with this solution. The lumen of the cystoscope is flushed through with the same solution. It is then rinsed in tap water, dried, and returned to storage.

Another solution which can be used is made according to the following formula:

Isopropanal (99%)—900cc.
Methanol—72cc.
Formalin (37%)—144cc.
Benzalkonium chloride (12.8%)—14.4cc.
Sodium nitrite—18 grams
Distilled water—q.s. 1800cc.
The instruments are allowed to soak for three hours.

Q. In the April 1953 issue of HOSPITAL TOPICS, the Question Box contained a method for using a steam sterilizer as a dry-heat sterilizer. A hospital in this state has used this method satisfactorily for some time. However, in attempting to find out whether the same method could be used in an electrically-operated steam sterilizer, I called one of the local representatives of a well-known manufacturer of autoclaves.

He opposed the use of this method for the following reasons:

An electrically-operated sterilizer could not be left over night, as the water level would need to be watched.

There is no way by which the temperature inside the chamber could be checked or controlled. He doubted that it would reach 250°. The amount of heat escaping into the room would affect the amount of heat contained in the chamber—that is, a free-standing autoclave would dissipate more heat out into the room and less into the chamber than would an enclosed one.

This is an expensive use of steam, and the cost of a dry-heat oven would be saved in a couple of months' time over the amount of steam or electricity which would be used by this method.

May I have a further discussion on this method along the points which the company representative has raised?

I find that many of the hospitals purchase the dry-heat ovens and then seldom use them. Some of their methods of sterilization, especially of VASELINE Petrolatum Gauze, are questionable. Also it would be labor-saving to be able to sterilize the plungers and barrels of syringes already assembled. Because of the one hospital's enthusiastic recommendation of the dry-heat autoclave methods, I have been recommending it. But since the above points have been raised I have been doubtful.

A. The objections posed by the local representative of the sterilizer manufacturer are not valid. An electrically-heated sterilizer operated with steam confined to the jacket only would not lose steam and would not have to have the water level supervised.

With door closed, heat losses in the chamber are minimal, and the radiant energy provided by the hot jacket surrounding the chamber wall will heat the contents of the chamber throughout. In this regard there is no difference between a free standing and a recessed sterilizer.

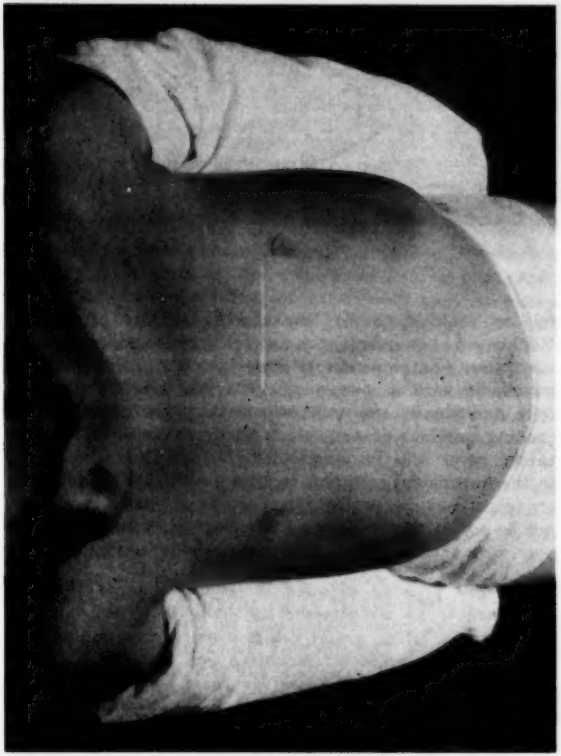
Unfortunately, dry-heat ovens of a quality adequate to the task are not inexpensive, and the amount of energy dissipated in keeping them hot is comparable to that used in the steam sterilizer. In a large hospital a forced air dry-heat oven is indispensable for this purpose, but in many small hospitals this duplication of equipment is extravagant. In very large hospitals with bulk sterilizers such equipment can be used advantageously as a dry heat sterilizer during the night time.

Q. Is it possible to obtain sodium hypochlorite in powder form so that pharmacists can make solution strengths desired? What drug company or companies have it? Is it safe for rubber goods to be soaked in it?

A. Sodium hypochlorite can be purchased as a 10 percent concentration from any wholesale druggist and surgical supply house. Your pharmacist can then dilute it to whatever strength you desire. The use of sodium hypochlorite as a disinfectant is described in detail in my monograph, *The Aseptic Treatment of Wounds.*

Rubber goods should not be soaked in sodium hypochlorite solution because it will hasten their deterioration. They can be deodorized and disinfected by wiping them and immersing them for a brief period of time in a 1:1000 solution.

A 1:1000 solution is adequate for disinfection of floors, toilets, and mops.



Efficient Restrainer

● An efficient method of restraining small children in the operating room, used for many years at the Children's Orthopedic Hospital, Seattle, Wash., has been sent to us by M. Malcolm, surgery supervisor. Miss Malcolm says the method is easy to apply and there is less danger of the patient's hands slipping or being traumatized by this practice than by individual restraint. The restrainer may be applied to the lower extremities as well.

Miss Malcolm gives these directions to nurses. Fold a diaper in thirds lengthwise. Bring the ends of the diaper together and place under the child. Insert one arm in this fold. Pull the diaper towards you until the arm is brought snugly against the flank. Take the top layer of diaper between the opposite arm and the side, pull around the arm and pin with three safety pins to the bottom layer of diaper. The restrainer holds the child securely and safely.

Question Box

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Q. Do you advise wiping the operating room walls with aqueous Zephiran 1:1000 as part of routine procedure after a contaminated case?

A. The walls of an operating room are not routinely washed after a contaminated case. If there are spots of blood and pus they are wiped off immediately with a solution of aqueous Zephiran 1:1000 or sodium hypochlorite 1:20,000.

Q. We use aqueous Zephiran 1:1000 for storage of suture tubes. Should these suture cans (which contain tubes) be cleansed and re-autoclaved weekly, or is this solution of Zephiran adequate to maintain their sterility?

A. Aqueous Zephiran 1:1000 is not a good germicide to be used for the disinfection and storage of suture tubes for two reasons. First, it is not a fat solvent. Therefore, bacteria which are trapped under greasy fingerprints are not exposed to the germicide. This means that the tubes must be very tediously washed and dried before they are put to soak. Secondly, the specific gravity of aqueous Zephiran is not sufficient to keep the tubes submerged. Suture tubes and ampoules of drugs are best disinfected in a germicide with a low specific gravity and alcoholic content, and ideally one with germicidal vapors, so that protruding portions of ampoules and tubes inside of the container cover will be disinfected. A dye should be added to the germicidal solution, so that cracks in the ampoules or tubes may be easily detected. Dyes, however, should not be added to germicides indiscriminately because many are incompatible and decrease bactericidal action.

Q. Please give us detailed instructions as to the care of bronchoscopy instruments following their use in tuberculous cases. Also, would you give us information on care of anesthesia equipment including gas machine following use on a pulmonary tuberculous case?

A. Immediately after use, bronchoscopic instruments and anesthesia equipment which can be soaked are dropped

into a 1:1000 solution of calcium hypochlorite. This is made by using a teaspoon of ordinary chlorinated lime in a liter of water. The bronchoscope, anesthesia mask, etc., are washed with this solution. The lumen of the bronchoscope is flushed through with the same solution. They are then rinsed in tap water, dried and returned to storage.

Q. There has been considerable discussion among the nurses and doctors of our teaching staff about the technic advertised by the Edward Weck Co. of sterilizing catheters in cellophane tubing. Three major questions confront those of us who attempt to teach technics of sterilization: (1) If both ends of the cellophane tubing are secured with paper clips previous to autoclaving, how does steam penetrate the cellophane during sterilization? (2) Articles sterilized in this method are considered sterile for an indefinite period of time. Is there authoritative material on this subject? (3) Articles in cellophane must be wet in order to be sterilized in this manner. We find that our catheters must be well powdered, and therefore dry, to withstand autoclaving.

A. Our experience with the cellophane tubing for packaging catheters indicates that best results are obtained when one end of the tube is clipped following sterilization. The end through which the catheter is normally withdrawn is clipped prior to sterilization; the opposite end is folded over and clipped following sterilization.

Articles sterilized by this method remain sterile for an indefinite period of time. You will find references to this in the article quoted in the Weck advertisement.

It is always wise to have the lumen of the catheter moist when it is put in the sterilizer to insure prompt air clearance. There is little difficulty with the technic when the catheters are simply drained, packaged, and sterilized as described.

Q. We note that you recommend Congoleum Nairn as an operating room floor, as well as the Legge and Federal Flooring, both of which I believe are troweled on. In your opinion, is the Congoleum able to withstand the weight of heavy objects such as an operating room tables?

A. Congoleum Nairn conductive flooring has been used in this hospital (Peter Bent Brigham, Boston) for 12 years. During that time, the center section of the operating room has been replaced twice. We feel that this is relatively inexpensive floor service. When you have your new floor installed, make certain that the section leading from the main door of the operating room goes across the entire room and that floor on either side abutts this. When the center section which receives most of the traffic wears, it can be replaced easily with a new section without difficulty.

Q. Our operating room floors are conductive hubbelite, and our operating room corridor floors are master plate colored concrete, which are also conductive, but not to the extent of the hubbelite. As I understand it, some waxes are non-conductive, and will reduce the conductivity of the concrete floor, but there are conductive waxes. We use Masterbuilders' Concentrated Colored Wax. Is this conductive? If not, could you suggest a brand that is?

A. I am not familiar with the concentrated colored wax you mention, but am almost certain it is non-conductive. You can obtain conductive wax from Walter Legge Corp., 101 Park Avenue, New York City. You should also purchase a conductivity meter so that you can test your own floors periodically.

Technic for Prevention of Severe Hypothermia During Infant Surgery

By Edgar A. Bering, Jr., M.D. and Donald D. Matson, M.D., Neurosurgical Service
The Children's Medical Center, Boston

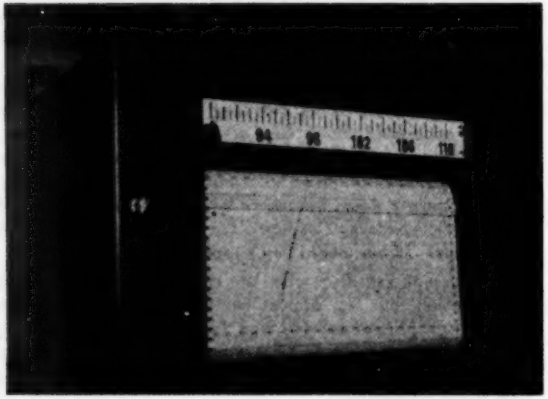


Fig. 1 The recording Potentiometer. The temperature is constantly recorded on the moving chart below the indicator on the large scale.

● The difficulty of maintaining a steady body temperature is a well recognized problem in the surgery of infants.[2, 4, 5] This does not imply that the temperature must be kept at 98.6° F, but it is desirable to prevent it from falling to dangerously low levels. Many methods of maintaining temperature have been suggested, but they are not completely satisfactory. Surrounding the infant with hot water bottles is the most common method of dealing with this problem, but recently, heated operating tables have been devised which are said to work well.[1, 3] The Neurosurgical Service of the Children's Hospital has developed a technic for positive temperature control which utilizes a constantly recording thermometer and an electric blanket.

The recording thermometer consists of a Brown Electronic Strip Chart Recording Potentiometer (Model No. 153X10W-X-20)* connected to a nickel resistance thermometer bulb. This thermometer bulb has been especially

*Brown Instrument Company, Philadelphia.

We are very grateful to the General Electric Company and especially Mr. R. G. Holmes of the Automatic Blanket Division for their efforts in developing the blanket.

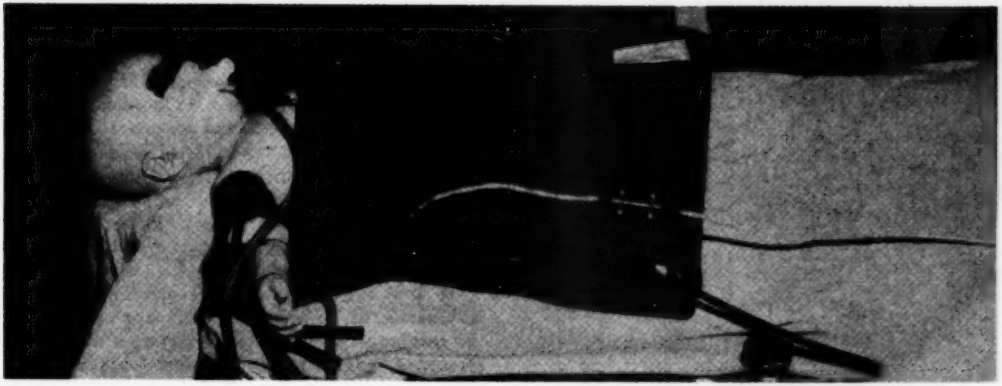
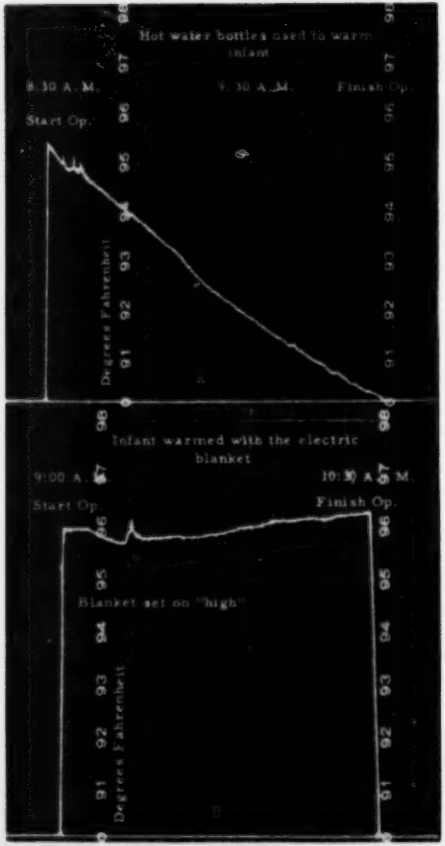


Fig. 2 Infant in position for frontal craniotomy with the electric blanket in position. The wire from the thermometer bulb in the rectum is shown emerging from the lower right hand corner of the blanket.

designed for use as a rectal thermometer in infants and children because the usual thermocouples were either too large or insufficiently sensitive for this purpose. The range of the instrument is 90° F. to 100° F. This narrow range is important because it brings out small fluctuations in temperature; one degree change of temperature causes over a half inch movement of the recording pen. The recording chart is shown in Fig. 1.

The electric blanket is a General Electric Company experimental model especially constructed for operating room use in the presence of explosive gases. It is covered with a conducting material which is grounded through the power supply cable. The temperature, which has a maximum slightly over 100° F., is controlled by a ten step regulator switch. The switch, although shockproof, is placed well away from explosive gases. The blanket measures 40 x 22 inches over all, but is designed to be folded in the middle and can be closed with snap buttons on two sides. This allows it to be used as a bottom or top blanket or to cover the patient on all sides. The open side and end allow access to the patient for intravenous tubes, thermometer wire or other apparatus, and for any exami-



nation required during the procedure.

At operation, the patient is appropriately placed in or on the electric blanket as dictated by the size of the patient and the nature of the operation; the recording thermometer bulb is placed in the rectum and the operation proceeds in the usual manner. The blanket temperature is regulated throughout the operation as indicated by the patient's temperature. Overheating is prevented by turning off the blanket as the temperature approaches the desired level. This technic has been used routinely in all neurosurgical procedures on infants for more than a year with no unfavorable results (Fig. 2).

A striking example of the efficacy of this technic is demonstrated by comparing temperature recordings from infants undergoing arachnoid-ureterostomy[6] for the treatment of hydrocephalus. Before obtaining the electric blanket, eight such operations were done using hot water bottles to maintain the body temperature. In all but two of these infants the temperature dropped during the operation to about 93° F. to 94° F., and reached 90° F. or lower in three cases. In 13 such operations, the electric blanket has prevented such appalling drops of body temperature, and when infants were hypothermic before the operation, they were slowly warmed during the procedure. Fig. 3 shows the temperature charts of two infants undergoing arachnoid-ureterostomy; one patient was heated by hot

Fig. 3 Temperature charts of two infants undergoing arachnoid-ureterostomy for the treatment of hydrocephalus. A is the chart of an infant warmed by hot water bottles. B is the chart of an infant warmed by the electric blanket.

water bottles and the other was heated by the electric blanket.

This example shows the extreme situation, but it serves to demonstrate the efficacy of the method. The smaller temperature fluctuations of other procedures are handled just as easily . There is no question that the early post-operative recovery of infants undergoing all types of major neurosurgical procedures has been uniformly and strikingly accelerated when severe hypothermia has been obviated.

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BOOK REVIEW

Surgical Nursing

By Robert K. Felter, M.D., Frances West, R.N., and Lydia M. Zetsche, R.N., 6th edition, 1953, 768 pages, illustrated, pub. by F. A. Davis Company, Philadelphia

The duties of the surgical nurse have become so highly technical and varied that it is difficult for the student to understand the reason for many of the complicated procedures. In this book, the authors successfully accomplish the aim of teaching the pathologic processes involved, the purpose of the surgical procedure, and the other background material which enables the reader to provide surgical nursing care with a purpose.

There are 363 illustrations in this book, all of them being well chosen to clarify the text. Of these, 108 are new since the last edition, indicating the thoroughness with which the authors tackled the job of bringing this work up to date.

This is a book which is equally useful as a reference source for the graduate as it is for a text for the student nurse. It is carefully written to assure accuracy.

The body systems are treated separately, and there are general sections on basal pathological states, surgical skills and nursing, and the nurse in the operating room. The book is a companion to "Medical Nursing," and both books have been integrated by a cross-reference system.

Electrostatics in the Operating Room

By Carl W. Walter, M.D., Boston, Assistant Clinical Professor in Surgery, Harvard Medical School

● Electrostatic hazards are a complex problem in the operating room because people firmly and persistently insist on being people. The scientific aspect of electrostatics in the operating room is simple and straightforward. Successful application of this knowledge is skillfully evaded, although everyone concerned makes a fetish of using some small fragment as a balm to his conscience. Despite the faulty control of electrostatic discharge, accidents are rare, and the experience of hospital personnel seems to justify the complacence and lack of interest widespread in the profession.

The problem exists because gaseous anesthetic agents, to be effective, must be soluble in the lipid membranes of the brain. Unfortunately such agents are also flammable. Flammable mixtures of these agents and oxygen are in common use. Explosive combustion of an anesthetic mixture occurs about 120 times annually with perhaps 30 fatalities, according to insurance carriers. Anesthesiologists record an accident once in 80,000 inhalation anesthesias. The best estimates are that 7,000,000 inhalation anesthetics are given each year—a comparable incidence considering that data of this kind are difficult to compile. The accident rate does not differ materially among various inhalation anesthetic agents in common use.

Institutional compliance with reasonable and economical safety measures aimed at the control of electrostatic hazards awaits effective education of the many forces that pattern human behavior. Thus far, negative influences have had undue influence in that the usual avenues of information—the surgical and building trades—have continued to exploit unsafe materials, equipment and technic, shirked responsibility of cleaning up designs and practices, and failed to take a positive stand in the publicity, advertising and detailing of their wares.

Professional groups which guide institutions in the field — architects, engineers, government services — have been derelict in that they are prone to perpetuate established practice, fall prey to adverse rumor concerning new developments, and fail to visualize the broad function of materials and equipment in patient care.

Within the hospital, ignorance and negligence often sit at the conference table when decisions are made in this area. Safety programs are enforced by incompetent or lax employees with no appreciation of the goal of their efforts.

The codes are an additional confusing factor. These are often conflicting and impractical. Too few are based upon functional minimal requirements; most accomplish nothing in existing structures; compliance is prohibitively expensive.

Four factors operate simultaneously to produce explosive combustion of anesthetic gases in the operating room.

A flammable gas and the presence of oxygen are two factors also essential to patient care. The third, a source of ignition, is the ingredient that requires rigid control. Heat (365°F. or over) is used in the operating room in the form of flame, electric hot plates, the hot wire cautery, photographic bulbs, cigarettes, etc. Electric sparks are common. Power and lighting circuits contribute commutators, switches, receptacles, faulty cords, and insulation failure as sources of sparks of sufficient energy to be hazardous. Electrostatic discharge of a 1000-volt spark has sufficient heat to cause ignition. The final factor, carelessness, that mixes the flammable gas, oxygen, and the source of ignition is of the willful variety that to date evades correction.

Control of the explosion hazard in a situation where all the ingredients of a disaster must often be present implies minimizing the chance of all four factors being operative simultaneously.

The anesthetic mixture of the combustible gas can be confined to the anesthesia machine and the patient's respiratory passages by using a closed technic of administering the gas. Under such circumstances the evidence is that a combustible mixture is not encountered beyond a radius of six inches from the gas transmission system and the patient's face. Some anesthetic agents are present in the liquid phase and subject to spilling, or some gaseous mixtures are heavier than air, so potentially flammable mixtures cascade to the floor beneath the anesthesia system and pool on the floor. The hazardous area is therefore defined as extending to a radius two feet from the anesthesia machine and the patient's head and a similar distance above the floor.

Once the hazardous area is defined, carelessness on the part of untrained personnel can be mitigated by indoctrinating them on a gross and understandable level to keep away from the anesthesia stage at all times.

Sources of ignition can be eliminated partly by decree —no smoking, no hot plates, use of Underwriters-approved electrical appliances, etc.; partly by design, locating electrical wiring five feet above the floor out of the hazardous area, providing a means for dissipation of electrostatic charges, etc.; partly by a continued, studied effort to apply the minimal requirements of Bulletin 56 of the National Fire Protection Association effectively at every operation where inhalation anesthesia is used.

All this is by way of orientation. Electrostatic discharge is credited with the responsibility for the majority of the accidents that occur.

Safety from the electrostatic hazard rests upon a tripod depending for support on proper structure of the operating room, well designed equipment, and proper behavior of personnel.

Two principles are involved in control of this hazard: one, to prevent rapid build-up of potential; the other, to provide a conductive pathway over which the inevitable accumulation of electrostatic charge can leak away.

Safe structure is the basis of control in that a conductive operating room floor forms the electrical pathway interconnecting everything and everyone in the room. There has been much confusion in arriving at a specification for a satisfactory floor. Conductivity is but one requirement of a functional floor for operating room use, yet because it is a relatively new concept and can be

measured, it has become *the* criterion. The suitability of the surface as an electrical contact is of equal import in the role of the floor as an interconnecting pathway. A macroscopically homogeneous surface is essential to insure uniform wear and provide an optimal electrical interface. To eliminate the shock and spark hazard a resistance of more than 25,000 ohms is desirable. Grounding the floor serves no useful purpose in its function as an interconnecting pathway and introduces undesirable capacitance effects.

The evaluation of a good floor for the operating room must consider the following properties:

Optical. Absorptive color to eliminate reflection and glare. Black is best because it also reveals the usual dust and dirt found in the operating room.

Acoustical. Elimination of the clatter resulting from dropped utensils and deadening of sound are desirable.

Safety. Nonskid surface is important in a room where the surface is often wet with slippery fluids and falls are common.

Comfort. Resilience eases the strain of standing in one spot for long periods.

Aseptic. The surface must be nonporous, non-spawling and cracking, and as free of joints as possible, so that blood and pus can be cleaned up. Inherently bactericidal floors help control air-borne contamination. Insect repellency is also desirable.

Permanence. The surface must resist attack by biologic fluids—blood, pus, ascitic and amniotic fluid, and synthetic detergents and germicides. It must withstand the mechanical abuse of heavy casters, the scuffing of steel legs and feet, and the impact of upset equipment.

Safe furniture is made of metal or electrically conductive material. Surfaces on which movable objects may be placed are of unfinished metal. Electrical contact with the floor is established through conductive casters, tires, or leg tips. The resistance between the metal frame of the furniture and a metal plate beneath one supporting member must not exceed 250,000 ohms. Careless design of furniture often introduces hazard. Insulating treads on stools or silencing rubbers between the frames and the stainless steel tops of furniture break the conductive pathway. Furniture must therefore be tested by measuring resistivity between the functional surface and the floor to detect such faults in design.

Conductive casters are necessary on electrical equipment because it is often moved while disconnected from the power supply. Three conductor cords and plugs provide for routine grounding of the metal frame during use.

Anesthesia machines have two conductive pathways. The first provides electrical continuity between the structure of the machine and the floor as described for furniture. The second envelops the gas transmission system because, contrary to widespread belief, a charge accumulates on the inner surface of passages through which gas is flowing. Metal or conductive rubber is therefore employed to form the transmission system between the various elements of the anesthesia machine and the patient's face. Manufacturers of these machines, prompted by a reactionary profession and faulty government specifications, have been slow to standardize on a safe design or to advise revision of existing equipment. The Underwriters Laboratories have not established an inspection service for anesthesia machines, even though this equipment is

the very core of the hazardous area.

Maintenance of a conductive pathway requires continued surveillance of the surfaces that provide electrical contact. Nonconductive wax is often applied by the nonthinking. Dirt—bits of broken glass from ampoules or suture tubes, ends of sutures, layers of blood or pus—may accumulate on castors or leg tips to insulate them from the floor. Replacement of worn conductive parts by the ordinary variety occurs. Periodic testing must be done in the spirit of safety for the patient by an individual who understands that the purpose of the test is more than the mere compilation of a record.

Details of technic are essential to safety. Two instances suffice to illustrate how technic provides safety.

Operating tables cost $1,500. Conductive casters establish a conductive pathway to the floor. A 50-dollar sponge rubber mattress is isolated as a dangerous potential by a conductive rubber mattress cover. To prevent the discomfort of a chilling contact, a cotton sheet or blanket is stretched over the mattress, before the patient is put on the table. The whole purpose of safe structure, furniture, and equipment is negated because the blanket insulates the patient and increases the capacitance of the system markedly. Discharge of whatever potential accumulates on the patient may well occur in the superhazardous area between the patient's face and the conductive anesthesia apparatus or the anesthetist. This is particularly true at the end of the operation when the aseptic field is being removed and previously bound charges are abandoned to dissipate themselves. A 35-cent conductive strap fixed permanently to the metal frame of the table, where it can be thrown across the bare skin of the patient's shoulder or leg to bridge the insulating textile, provides safety. Yet no manufacturer supplies this essential detail or even advocates its use. Only a few hospitals enforce this technic.

Basins for glove washing are a part of the aseptic field. These basins are supported on a metal stand, draped with several thicknesses of sterile textile. The basins are thus effectively insulated from the conductive pathway. When germicide or detergent solution is poured into the basins from a glass container, a charge accumulates that may dissipate itself as a two-inch spark to the first hands that are thrust into the basin. A little solution spilled over the rim of the basin wets the textile and forms a conductive pathway.

Safety depends upon human behavior and integrity in six areas.

Personnel must be trained to stay away from the anesthesia machine and the patient's head. The philosophy of slow, deliberate motion must be drilled into personnel, particularly anesthetists. An electrostatic charge can accumulate only when the rate of generation exceeds the rate of dissipation over the conductive pathway. Slow motion in the hazardous area becomes an important safeguard where contact with the conductive pathway is marginal.

Dangerous fabrics must not be worn. Freshly laundered cotton is essential for both electrostatic control and aseptic technic. The build-up of electrostatic charge on wool and synthetic cloth is so rapid that these materials are outlawed except when the entire garment is worn in direct contact with the skin, which serves as the leakage path for the dissipation of the charge. For example, nylon hose present little hazard once the soles are moistened

with perspiration; a petticoat, on the other hand, is dangerous, because the free-hanging skirt becomes charged through motion. Synthetic material is such a good insulator that the charge remains even though the bodice is in contact with skin.

There must be personal responsibility for maintenance of a conductive contact with the floor. Conductive soled shoes, conductive booties, or slip-ons are effective only when they are worn. They must be tested daily because dirt collects on the bottom to destroy the electrical contact. A testing device and an inverted wire brush fixed to the floor should be standard equipment at the entrance to every operating room corridor so that faulty contact can be detected and corrected.

Because dirt interferes with electrical contact, personnel must be trained to keep the floors clean. The surgeon who discards suture ends to the floor, the nurse who drops broken glass or fails to clean up blood or pus before it is tracked about, contribute to the hazard.

It is almost superfluous to mention control of sources of ignition such as cigarettes, flames, sparking electric appliances and the like, yet offenses of this type are common.

A complex problem in education is defined by an analysis of the electrostatic hazard in the operating room. Put in its proper perspective, the hazard is the cause of minute mortality. Time, effort, and money are more wisely spent in providing adequate sterilizers, vacuum cleaners, surgical lights, anesthesia machines, and indeed operating rooms themselves to combat an appreciable surgical morbidity and mortality.

The motivating philosophy of the National Fire Protection Association's Committee on Hospital Operating Rooms has been to establish functional standards that reduce the explosion hazard to a minimum. Most of the provisions are qualitative and point the way to economical prevention of the rare death. It has served to crystallize the application of knowledge, so that an intelligent choice can be made in favor of safe materials and technics. It has pointed out the need for redesign of equipment based on the concept that safety is also a part of function. The absurdities of elaborate explosion-proofing, excessive ventilation, high humidity, and electrostatic detection have become obvious as the various members of the committee with backgrounds foreign to surgery have come to recognize the special orientation of the problem in the operating room.

The most important factor in safety is building an attitude in the staff that is alive to the hazards and recognizes personal responsibility for the safety of all patients. Safety cannot be legislated into the surgeon-patient relationship. Young people and junior members of a staff are cooperative and extend their concept of patient care readily. Careless disregard for such refinement is frequent among the senior members and administrators. These groups have "gotten away" with current practice so often that they feel exempt from electrostatics as a source of ignition and feel that lightning doesn't strike often enough to warrant precautions being taken.

Reprinted with permission from Bulletin of the American College of Surgeons, Vol. 38, July-August, 1953, pp. 141-144. The paper was presented before American Institute of Electrical Engineers' Committee on Safety, New York City, in January.

Training Technicians for the Operating Room

An article by Marie E. Zulauf, R.N., Operating Room Supervisor, Passaic General Hospital, Passaic, N. J. Presented at the New Jersey Hospital Association meeting, Atlantic City.

● Late in the spring of 1952, we found that the personnel problem in our operating room was becoming so increasingly difficult that emergency measures were necessary to alleviate the situation.

After considerable discussion, the Operating Room Committee decided that, since it was impossible to find an adequate number of nurses to staff the operating room, we would use technical aides.

It was concluded that the individuals best qualified for technicians were third or fourth year pre-medical students, who would not only have some medical background and interest in surgery, but also, would benefit by what they would be able to observe.

Four applicants were selected. They were used as orderlies while they were given basic instruction, including every concept of sterile technic. The young men always worked with a registered graduate nurse, under supervision of senior surgeons of the staff, and with cooperation of the junior surgeons.

After a month of formal teaching, demonstration, and observation, the aides were taught the principles of scrubbing, and with a graduate began to scrub on routine surgery. When they proved themselves capable of scrubbing confidently and well, they were permitted to scrub alone, with a graduate circulating in the room.

These aides worked a 40-hour week, and when they were competent were on night call with a graduate nurse. The salary was $40 weekly with additional compensation for night calls. If calls were excessive, extra time was allowed.

The arrangement proved so satisfactory that we are making use of aides again this summer.

At present, we employ two young women to supplement the staff as technical aides. Both were student nurses who did not complete their training. They received the same basic instruction as the pre-medical students and have had the same supervision and direction. They handle no drugs, but are permitted to circulate and assist with supplies and

cleaning of instruments and equipment. They are on duty 40 hours a week and take night call with a graduate.

We have scrutinized the *Program for Operating Room Technicians* published by the Department of Hospitals, City of New York, and we feel that our aides more than fulfill the qualifications required in the Program.

PROGRAM OF TRAINING FOR OPERATING ROOM TECHNICAL AIDES

PURPOSE

1. To afford adequate orientation to the hospital, medical, and nursing staffs and operating room.
2. To acquaint the aide with the personnel policies of the hospital.
3. To acquaint the technical aide with professional ethics.
4. To help the aide to adjust well to the surgical routine by thorough instruction, demonstration, and practice in the various surgical procedures.

PLACEMENT OF COURSE

All new applicants for the position of operating room technical aides.

TEACHING PERSONNEL

1. Supervisor
2. Assistant supervisor
3. Surgeons

TIME

Theory—30 hours including:

1. Explanation of surgical asepsis
2. Scrub technic
3. Gown and glove technic
4. Care of a "clean" room
5. Care of a "contaminated" room
6. Short history of surgical progress
7. Microbiology
8. Care and cleaning of instruments and equipment
9. Methods of sterilization
10. Suture material
11. Instrumentation
12. Surgical positions
13. Anesthesia
14. Medical terms relating to surgical procedures

PRACTICE

1. Demonstration of operation of equipment
2. Demonstration and practice of surgical setups:
    a. Linen
    b. Instruments
    c. Sutures
    d. Draping
3. Preparation of patients:
    a. Routine laparotomy
    b. Vaginal and rectal
    c. Orthopedic or traumatic

QUALIFICATIONS

1. Age 18 to 45
2. High school graduate
3. Some medical background preferable e.g. premedical student or one who has not been able to complete a nursing course

4. Average intelligence
5. Poise and stability
6. Capability and willingness to work
7. Moral and physical well being
8. Neat appearance
9. Pleasant personality
10. Accuracy

ACTIVITIES

PATIENT

1. Assist in moving patient from stretcher to table and back to stretcher
2. Remain with patient before operation.
3. Adjust ether screen
4. Restrain patient

ASSISTANCE WITH OPERATION

1. Sterile set up
2. Draping
3. Instrumentation
4. Sutures
5. Sponges
6. Assist with undraping and adhesive to dressing
7. If unsterile, tie doctors' gowns.

EQUIPMENT AND SUPPLIES

1. Instrument sterilizers; operation and cleaning
2. Boiling sterilizers (used only to heat saline) cleaned
3. Clean instruments and place in sets
4. Clean and check rooms
5. Tie sponge packs
6. Pad basswood splints for armboards
7. Roll silk and cotton supply
8. Prepare and string tonsil sponges
9. Clean and refill brush containers
10. Clean and check instrument closets

HOUSEKEEPING

1. Rinse soiled linen
2. Replace linen supply in rooms

Neurosurgery as it Pertains to the OR Nurse

By John Griffin, M.D., Denver

Presented before a recent meeting of the Denver Association of Operating Room Nurses.

● The surgical nurse who assists in neurosurgical procedures finds her job considerably different from the routine she is used to in general surgery. It is probably because of this that many nurses dread neurosurgery. Perhaps a brief discussion of methods and needs of the neurosurgeon may make the nurses' job more enjoyable and less difficult.

Probably the most striking difference between neurosurgery and other types of surgery lies in the methods of controlling bleeding. Because of the limited exposure and the character of the blood vessels associated with the brain and spinal cord, it is usually impossible to use

Dr. Griffin explains the use of instruments used during surgery.

ligatures. More frequently, silver clips, electro-coagulation, suction, and application of muscle or one of the cellulose preparations are necessary. Bleeding from bone is controlled with bone wax. It will help if the nurse familiarizes herself with the silver clip applier, plans the table setup so that the electro-coagulation unit is easily accessible, and has a ready supply of cottonoid strips of varied sizes available. Of course there are many preferences on the part of the surgeon as to the width and length of such strips, or whether he likes a suture tied around each strip, etc., but she will find out these preferences before the operation. It also helps if she tries to keep track of the strips in the wound, as with brisk bleeding the surgeon finds himself well occupied. A rack for varied sizes of cottonoid is very useful.

NURSE IN DIFFICULT SPOT

Due to the unusual positions required in some neurosurgical procedures, and the methods of draping and setting up the instrument table, the nurse is often in a situation where it is difficult for her to see what is going on, and must be prepared for sudden needs of silver clips, dural sutures, bone wax, etc. In most craniotomies it is desirable to have the nurse's table over the patient's head where the surgeon can reach up and forward and ask for what he needs. He could also be helpful by warning the nurse in advance of what he might need during the next phase of the operation. Likewise he will aid her by letting her know he is through with the bone instruments or scalp clips, etc.

Because of the method of draping from the head to the instrument table, the nurse usually needs a stool and is higher than the operative field. Obviously, one need not mention the danger of handing the surgeon an instrument over the exposed brain. He should always take the instrument away over the table. The exposure in neuro-surgical procedures is necessarily limited and requires the surgeon to keep his eyes on the field. He should not have to look up, but should have the instruments handed to him, and should have the cottonoid in a place near the field so he can reach it quickly and easily.

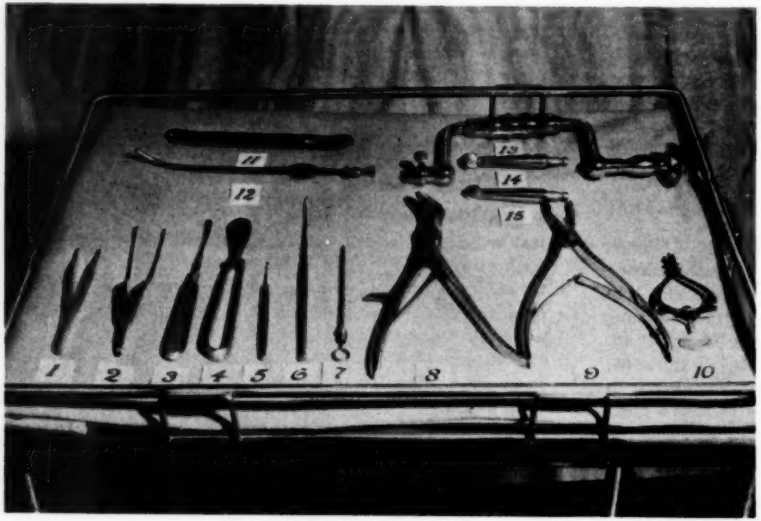
As far as draping is concerned, there are many methods. Some sew the drapes on, particularly in craniotomies, where towel clips may get in the way, but here again, the nurse can easily inquire about this beforehand. There are many procedures which are done preferably in the sitting position, except in children who do not well tolerate such a position. These are mainly ventriculograms, sub-occipital craniotomies, cervical laminectomies, and dorsal sympathectomies. Perhaps in no other field is the position of such importance, and if the surgeon seems over-meticulous about the position, it is because he has learned from experience the difficulties of faulty positioning. Naturally the sitting position in special head rests puts the nurse in an even more out of the way situation.

In addition to these routine needs, the nurse should have a steady supply of warm saline, with a thermometer to keep the temperature at 100° if possible, and at least two asepto syringes, which she can help keep filled. Many new internes get the impression that neuro-surgery consists mainly of washing and suction.

Of course a familiarity with neurosurgical instruments is essential. Many instruments have been modified from

(*Continued on page 96*)

Figure I: Neurosurgical Instruments used in Ventriculography and for Removal of Subdural Hematoma.

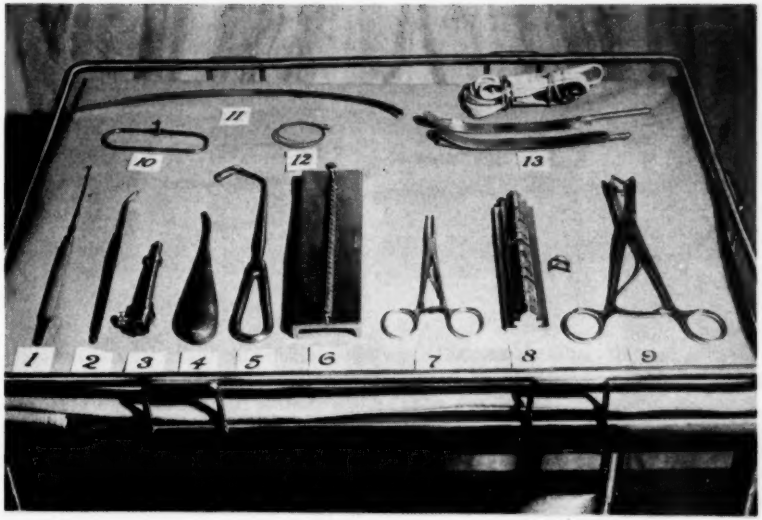


Tray No. 1

1. Adson Tissue Forceps.
2. Adson Dressing Forceps.
3. Adson Periosteal Elevator.
4. Adson Periosteal Elevator, Wide.
5. Frazier Dural Hook.
6. Sachs Dural Hook.
7. Frazier Ventricular Cannula.
8. Cranial Bone Rongeur.
9. Adson Cranial Bone Rongeur.
10. Jansen Mastoid Retractor.
11. Cushing Brain Depressor.
12. Adson Suction Tube.
13. Hudson Brace.
14. Hudson Burr #5.
15. Hudson Burr #3.

These instruments are kept sterile at all times and are referred to as "Craniotomy Instruments #1." Also in the tray are asepto syringes, syringes for administering local anesthesia, assorted needles, both local and spinal, Penrose drain, small rubber catheters #10 and 14, and assorted sizes of cottonoid. (Cold sterilization is used for sharps, dura hooks.)

Figure II: Additional Instruments Used in the Neurosurgical Set-Up.



1. Adson Blunt Dissecting Hook.
2. Frazier Dura Elevator.
3. Hudson Brace Extension.
4. Volkman Periosteal Elevator.
5. Cushing Decompression Retractor.
6. McKenzie Clip Holding Rack.
7. McKenzie Clip Applying Forceps.
8. Adson Rack for Scalp Clips.
9. Adson Scalp Clip Applying Forceps.
10. Gigli Saw Handle.
11. Bailey Conductor for Gigli Saw.
12. Gigli Wire Saw.
13. Adson Lighted Retractors with Cord.
14. DeVilbiss Cranial Rongeur Forceps.
15. Adson Hypophyseal Forceps.
16. Love-Gruenwald Forceps.
17. Weitlaner Retractor.
18. Beckman-Adson Laminectomy Retractor.

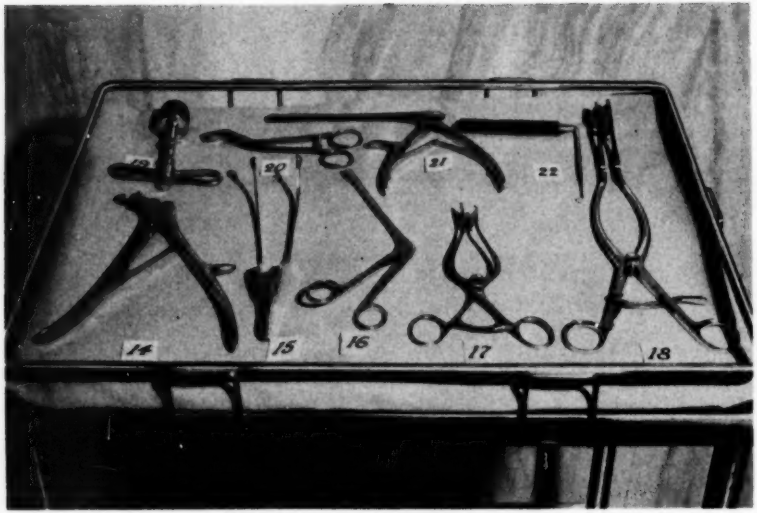


FIGURE II continued

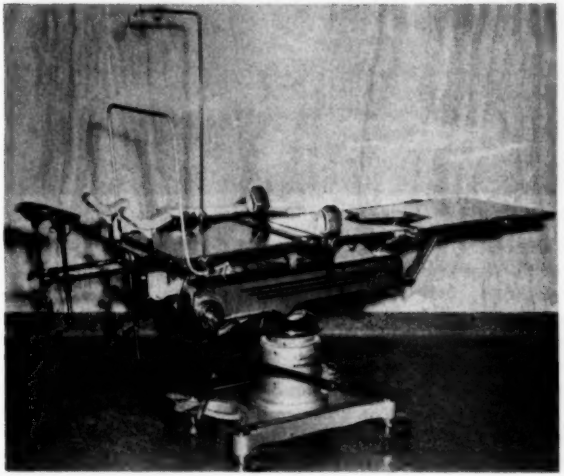
19. Cranial Trephine.
20. Adson Drill Guide and Dura Protector.
21. Colclough's Laminectomy Rongeur.
22. Love Nervè Retractor.

The additional craniotomy instruments are also kept sterile at all times, and are referred to as Craniotomy Instruments #2. The neurosurgical instruments used in laminectomy operations are kept in Laminectomy Instrument Tray which is also kept sterile at all times. (Cold sterilization is used for Adson Lighted Retractors and Cord.)

ENT. another field where exposure is limited. She should know the difference between a perforator and a burr, how to handle scalp clips, saw guides, gigli saws, various types of rongeurs, etc. The lighted retractors are often balky, and should be tested before surgery. The variations in preference of needles and sutures is of course another thing that the surgeon should tell the nurse previously.

One rather unique need is for the steel wire for replacing the bone flap — the bone drills, drill guide, etc. These things are more or less routine in most neurosurgical procedures, and perhaps by reviewing them and familiarizing herself with the instruments, and the surgeon's own personal likes and dislikes, the nurse will find neuro-surgery a very interesting field, rather than a chore.

Figure III: King Head-Rest. Used with the American Surgical Operating Table.



Used for:

1. Craniotomy in the prone posture.
2. Cervical laminectomy.

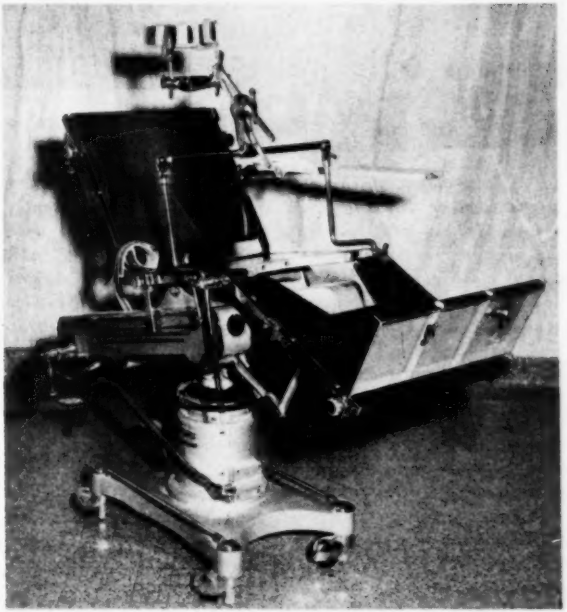


Figure IV: Craig Head-Rest. Used with the American Surgical Operating Table.

Used for:

1. Operations on the brain using either the suboccipital or parietal approach.
2. Operations on the upper portion of the spinal cord.

Question Box

Each month questions pertaining to O.R. problems and technics will be answered by Dr. Carl W. Walter, nationally known for his operating room technic courses and as the author of "Aseptic Treatment of Wounds" (MacMillan). Questions should be addressed care of the O.R. Editor, Hospital Topics.

Q. ***The problem of the sterilization of the syringes for intramuscular injections in this hospital has recently arisen. In the past we have sterilized all syringes with the plunger removed from their barrel, wrapped in individual cloth containers and autoclaved. It is the custom now to administer intramuscular injections of antibiotics at 9 o'clock in the evening and the personnel on the wards feel that it is a considerable nuisance to have to unwrap each syringe individually and fit the plunger and barrel together. Accordingly, they have wondered if it might be possible with safety to have the syringes bulk sterilized with the plunger and barrel assembled, and put them up in groups of say a dozen syringes. I should appreciate your comments concerning this suggestion.***

I have recently discovered that not infrequently the syringes are removed from their present packs, loaded with the penicillin or whatever the antibiotic may be and then placed in a refrigerator with a sterile towel covering them loosely. Frequently this is done several hours before the time of administration. I decry this practice, and would appreciate a definite statement from you concerning it.

Another problem that I have noticed is that frequently the anesthesiologist opens his spinal trays the evening before they are to be used, quickly puts the three necessary ampoules on the tray and then again closes the tray. This seems also to be a choice which is frought with danger and I should appreciate your reaction to it. The trays are not opened for more than a minute or two and of course the ampoules are placed thereupon with sterile forceps.

A. A convenient technic for the care and sterilization of syringes is to assemble the dry syringes and to protect the needle tip with a plastic sheath. The syringes are then sterilized in *dry heat* at 250° F. for six hours. This is readily accomplished by loading an ordinary steam sterilizer with syringes, turning the steam into the jacket but not the chamber and leaving the sterilizer on all night. The syringes are thus ready to use by merely forcing the

plastic tip against the syringe to break the seal before applying the needle.

Medication should not be permitted to remain in contact with the ground glass of the syringe any longer than necessary because the alkali interface in the ground glass will destroy many medications.

Sterile supplies should not be needlessly exposed to airborne contamination by the practice you describe. It seems so easy to put the necessary ampoules onto the trays just prior to use that there seems little argument in favor of the current practice.

Q. There is a certain amount of rust formation around the metal door frames, where they meet the hubbelite floors of our operating room. Our engineer feels that this is an electrolitic action which cannot be prevented. Have you any experience with this problem?

A. I would agree with your engineer's answer to the problem of rust formation.

Q. We are presently discussing methods of cold sterilization of sharps in our surgery and I would greatly appreciate your opinion.

A. The chemical disinfection of cutting edge instruments can be accomplished by several solutions. The Bard-Parker Improved Germicide can be safely used on clean instruments for a minimum of three hours.
You can also use a solution made of:

Isopaopanal (99%)—900 cc.
Methanol—72 cc.
Formalin (37%)—144 cc.
Benzalkorium chloride (12.8%)—14.4 cc.
Sodium Nitrite—18 grams
Distilled water—q.s.. 1800 cc.

It is safe to state that no known germicide at present actually sterilizes instruments. Even those which are treated properly in Bard-Parker's solution will grow out bacteria if they are incubated long enough in proper culture media. For disinfection of surgical blades, which is the chief problem, it is best to purchase blades presterilized such as are being offered by the American Safety Razor Company. Dry heat sterilizers are available, which can be used to sterilize scissors and other cutting edge instruments.

Q. What is the ingredient which can be added to Bard-Parker Solution to reduce the spore-killing time from 18 hours to three hours?

A. It is hexachlorophene (G-11) which when added to Bard-Parker solution, will reduce disinfecting time to three hours. Unfortunately, however, this cannot be purchased by the hospital. Hence, if you desire the accelerated action, you can buy the Bard-Parker Improved Germicide, which contains hexachlorophene.

Q. *At present we are reviewing our syringe and needle technic, checking the efficacy of our handling of instruments to minimize the hazard of homologous serum jaundice. In the process, we have found that scalpel blades are being sterilized by immersion in B. P. germicide solution. Since it is our impression that the inactivation of this virus can best be done by steam under pressure, we wonder whether you have any information about the effectiveness of such a disinfectant. I have been told that the*

Department of Health of Massachusetts has indicated that boiling for 30 minutes may be used as an alternate method for eradication of the virus and would like to learn your opinion about this.

A. May I suggest that you purchase packaged, sterilized scalpel blades in order to obtain a sharp, sterile blade without the sloppiness or expense of disinfecting them yourself. There is little data on the effectiveness of various methods of sterilization against the virus of homologous serum jaundice, for the obvious reason that there are no culture methods or test animals which can be used. Reasoning from analogy with other viruses, steam sterilization under pressure is the safest. We know that the virus is not destroyed by chemical disinfectant nor ultraviolet radiation.

Q. *Is one justified in increasing the sterilizing period of a laparotomy pack to one hour at 250°F. in order to secure a negative culture from the pack?*

A. The added exposure will hasten deterioration of the textiles. It would be more practical to rearrange the contents of the pack and limit the size so that penetration will take place in the standard sterilizing time of 30 minutes at 250°F. A thermocouple placed in the center of the largest package as described in Chapter 8 of "Aseptic Technic of Wounds" will help determine the sterilizing time necessary for your supplies.

Q. *At what temperature should blood be stored?*

A. Four degrees centigrade is satisfactory. The actual temperature is not important but it must be constant and s ould not fluctuate more than one degree. The blood should be warmed to 37° C. before being infused.

Q. *Who in a hospital can tell which electrical equipment is approved for operating room use?*

A. All accepted electrical equipment carries the seal of Underwriters Laboratories and can be readily identified.

Q. *We have been using the pHisohex, water, aqueous Zephiran 1:1000, 40 percent Isopropyl alcohol skin preparation, and it has proven most satisfactory. In a recent discussion our doctors expressed the desire for a more positive explanation of a germicide being used after pHisohex which we know the pHisohex Co. advises against. Could you give us an explanation?*

A. It is my feeling that pHisohex is a successful germicide only when it is applied repeatedly and consistently. After five daily applications the bacterial flora of the skin are suppressed to the vanishing point and remain so as long as it is used, except when respiratory disease causes such heavy contamination of the skin of the hands with virulent pathogenic organisms that it is a temporary escape from control. Contact contamination, particularly when accompanied by excessive implantation of soil or trauma (working in a garden, changing a tire, etc.), also gives a problem of temporary implantation of bacteria

on the skin and in the subungual spaces. It is my conviction that daily scrubbing with a nylon bristle brush is essential to keep the skin in optimum condition for easy disinfection. Because anatomic scrubbing is seldom practiced and because the subungual spaces are difficult to keep clean, I feel it imperative that a germicide with more militant properties, such as 1:1000 aqueous Zephiran, is a logical supplement for pHisohex.

In preparation for elective surgery, such as a bone graft, for example, it is possible to have the patient scrub the operative site for five days before surgery to attain control of the bacteria of the skin. For other types of surgery this is not possible and the plan which you outlined in your letter is much more satisfactory. I would add to it that the pHisohex should be developed into a lather on the operative site. The lather should be shaved off with a sharp, sterile, straight razor. The skin should be rinsed and then the preparation should be carried out as you described.

Q. I would like some suggestions as to what other hospitals use, or what you think proper for containers for sterilizing small amounts (such as ½ ounces) of ointments.

A. Ordinary ointment jars which can be purchased from a drug or surgical supply house are suitable for sterilizing small quantities of VASELINE or ointments.

Q. I am interested in your technic in using plastic tips for the sterilization of syringes. Would you give instructions for this procedure?

A. After the syringes are washed and thoroughly dried, they are assembled and a plastic tip is placed over the tip of the syringe. The syringes are placed in the steam sterilizer. Steam is turned into the jacket but *not* in the chamber. The syringes are left in dry heat for six hours at 250° F.

Q. How do you disinfect intubation tubes used in a tuberculosis case?

A. They should be scrubbed inside and out with a solution of calcium hypochlorite (chlorinated lime) made with four teaspoonfuls of chlorinated lime to a gallon of water.

Q. Does calcium hypochlorite have any effect on rubber?

A. Not if the articles to be disinfected are not left soaking. Drop the tubing, etc. in; flush through with the solution; rinse with tap water and dry.

Q. What procedure should be used when a patient with a contagious disease is operated on in a general surgery operating room? What precautions should be observed in positioning and handling of the patient? What precautions should be used in carrying out other duties of the circulating nurse during the operation? Should a contagious disease case be handled the same as any other contaminated case? I am thinking of patients with tuberculosis.

A. A patient with a contagious disease is treated as any other surgical patient in the operating room. The textiles and instruments are treated after operation as described in Chapter 15 of *Aseptic Treatment of Wounds*. Patients with tuberculosis should be masked while in the operating room. Care should be taken to avoid contamination of the clothing and shoes of operating room personnel with blood or pus from a patient with a contagious disease.

Safety from Anesthetic Ex

By Robin Beach

● The objective of this paper is essentially to advocate safety instruction and training of hospital operating-room personnel in the many ways and means of controlling the ever-present hazards of potential explosions in operating rooms from electrostatic ignition of flammable mixtures of anesthetizing vapors and air or oxygen.

Numerous sources of ignition other than the subtle little sparks from accumulations of static electricity may violate safety in operating rooms. Most of these are so obvious and so flagrant that, even to mention them, should impugn the intelligence of careful, responsible, and informed personnel who are dedicated to the preservation of life.

A lighted cigarette or an open flame, a glowing electric wire or an electric spark in electromedical or other operating-room specialty devices, an electric spark from the making or breaking of electrical circuits at outlets, extension cord connectors, or foot-controlled switches, all are hazardous in the extreme. Also a percussion spark from the striking of ferrous metals, and any one of several other causes of high temperature and of igniting energy within a flammable atmosphere, are obvious and potential sources of explosions.

Strangely enough, investigations have disclosed that explosions from the above-mentioned violations of safe practices account for many of the operating-room explosions. This situation being true for such obvious sources of ignition, surely to anticipate and prevent the insidious causes of ignition from electrostatic sparks require precautions of the most meticulous design, inculcation, and practice. Various phases of these safety measures will now be considered.

THE BIRTH OF ELECTROSTATIC SPARKS

Whenever any two dissimilar substances make contact, static electricity is developed between them. Electrons which comprise the minute components of atoms are negative electrical particles and, in solid materials, electrons only transfer across the contacting areas to cause electrification. Hence the accumulation of electrons on the one substance imparts negative electricity to it, and the lack of these electrons within the atoms of the other substance causes it to be electrified with an exactly equal amount of positive electricity.

Only when the two contacting substances are separated do they give outward evidence of their individual electric charges, possibly by sparks, and electrification occurs only

plosions in Hospital Operating Rooms

if one or both of the substances possess insulating properties which prevent the electrons from returning whence they came during the act of separation. Since no insulator is perfect, the amount of electric charge retained by each substance after separation, therefore, depends on the degree of insulating qualities of the two substances and how fast they are pulled apart.

Two conducting types of substances in contact also become electrified but during their separation, unlike insulating materials, the electrons all return whence they came. Thus no electrification remains on either separated conductor.

However, a dry cotton sheet flipped over and contacting an ether screen generates electric charge, develops several thousand volts, and may yield an igniting spark as it approaches, for example, the face of the patient or the grounded parts of the operating table.

Of course, the synthetic yarns composing garments of such textiles as nylon, dacron, orlon, dynel, rayon, and the many other hydrophobic fibers, all are superior insulators; and, once electrified, they may possess high electric charge and, also, they may retain it for long periods. Apparel of outer or under garments, or textile products, from any synthetic yarns and silk, sharkskin, wool, or the like, all should be unconditionally prohibited from anesthetizing areas.

When substances become electrified and separated, the difference of their potentials, called voltage, tends to unite the positive and negative charges through whatever insulating substances separate them. Given enough time the electric charges eventually leak away from the electrified substances and unite despite even the best insulating barriers. In high humidity atmosphere, such gradual leakage discharge is accelerated by moderately conductive films of moisture which condense on the insulating surfaces. Electrostatic leakage discharge in itself is harmless, but the presence of electrified substances in anesthetizing areas is most dangerous because of the possible occurrence of spark discharges arising from them.

A spark occurs whenever a conducting or grounded object, especially if provided with pointed or sharp parts, approaches close enough to either electrified substance to develop by electrostatic induction a sufficiently high voltage to cause the air between them to fail as an insulator and hence, like a miniature lightning stroke, to pass a spark discharge. The heat energy in even the feeblest electrostatic spark is sufficient to ignite critical flammable mixtures of anesthetic vapor and oxygen. An electro-

static spark as passed to a door knob by a person moderately electrified from walking on a rug contains about ten thousand times the threshold energy just necessary to ignite such critically flammable mixtures as cited above.

The character of the physical facilities in anesthetizing areas and the behavior and attire of those administering services in such hazardous locations determine whether electrostatic spark ignition of flammable mixtures may or may not occur. Let us examine what these determining factors are which influence potential explosions in hospitals both from the aspect of physical facilities and of human behavior.

SAFE FLOORING IN ANESTHETIZING LOCATIONS

The physical facilities throughout anesthetizing locations to provide safety from electrostatic ignition are predicated on the electrostatic dissipation principle. As here applied, in order to discharge static electricity as rapidly as it generates, this principle provides that moderately conductive properties shall be incorporated in flooring composition, in all floor-borne equipment and their component parts, and the footgear of personnel, with respect to the floor plane. Under these conditions no static electricity can accumulate, no high voltages can arise, and no sparks can occur. This principle appears to be simple, direct, and aimed at the crux of the electrostatic problem. In resolving it to practice, however, the electrostatic dissipation principle possesses many variable and compromising aspects, depends on numerous technical concepts, and involves the behavior of human agencies.

The Committee on Hospital Operating Rooms of the National Fire Protection Association has attempted to resolve this principle into its many facets and to provide appropriate controls for all electrostatic hazards through its pamphlet, "Recommended Safe Practice for Hospital Operating Rooms," referred to as NFPA No. 56, the last edition at this writing being dated 1952. Insofar as hospital administrators are concerned and their delegated personnel charged with the responsibility of safety in anesthetizing locations, the NFPA No. 56 constitutes their on-the-job Bible, together with whatever legislative regulations may be imposed by local urban authorities.

In arriving at its basic premise of control of static electricity and its potential ignition hazards, NFPA happily and wisely adopted the use of moderately conductive flooring to provide requisite conductive inter-coupling between all floor-borne equipment, personnel, and ground for the elimination of any intervening differences of electrostatic potential.

To achieve the objective of discharging static electricity as rapidly as it is generated, the magnitude of the electrical resistance in the discharge circuit through the floor is the determining factor. The NFPA No. 56 prescribes the value of the safe upper limit of floor resistance as 1 megohm, that is, 1,000,000 ohms, a resistance measured by the specified NFPA method using two 3-foot spaced test electrodes on the floor.

The U. S. Bureau of Mines, the National Bureau of Standards, and the writer have independently determined the safe upper resistance limit required to permit discharging the largest capacitors found in hospital operating rooms, such as an insulated operating table for ex-

ample, as 25 to 50 megohms under such maximum charging rates as are known to occur there. This concept of capacitor charging and discharging rates through resistance is illustrated in Figure 1. The safe upper resistance limit of 1 megohm, as specified in NFPA No. 56, seems so ultraconservative that the writer has strongly urged the Committee to raise this upper limit to 10 megohms—a value of resistance which still is conservative in the extreme.*

Before leaving this technical phase of the subject of safe physical facilities, the philosophy behind the selection of a safe lower limit of floor resistance needs clarification. The NFPA No. 56 specifies for this lower resistance the value of 25,000 ohms. In contradistinction to the NFPA selection of its ultra-conservative safe upper resistance limit, here its selection of the lower resistance limit seems so unreasonably low as to be fraught with hazardous potentialities of other than electrostatic types which also invite disaster in operating rooms.*

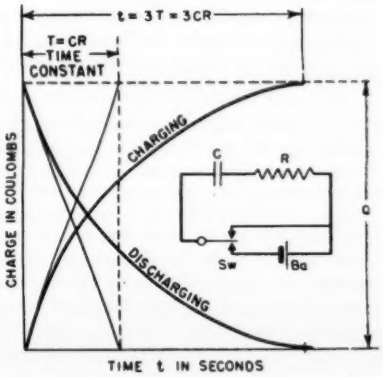


Figure 1. The time t in seconds required to charge or discharge a capacitor C is identical, and it varies with the circuit resistance R.

Unlike the upper resistance limit, the lower resistance limit is not determined or influenced by any relationship to static electricity. Rather, this safe lower resistance limit is determined by two important prerequisites—one to eliminate potential electric shocks to members of the operating-room personnel and the other to eliminate potential ignition of flammable mixtures by electric arcs. Both of these possible hazards originate from faulty electric cables or appliances connected to the 125-volt electric service whereby a "live" wire or part may touch the floor or any floor-borne equipment, including personnel.

Since an alternating current as low as one milliampere entering the human body from contact with an exposed "live" wire or faulty electrical appliance or electrically charged floor or piece of floor-borne equipment can cause a startling muscular response or tingling shock sensation, this low current of one milliampere should be considered the threshold value at which protection from electric shock by resistance control is necessitated.

The limiting resistance to control the current to one milliampere on a 125-volt circuit is indicated in the order of 125,000 ohms. Likewise to control the energy to the threshold of ignition in an electric arc of one milliampere requires the same order of resistance of 125,000 ohms. Hence, using only a token factor of safety of two rather than a really conservative value, the minimum safe lower

*See Ed. note on page 119.

resistance limit of 250,000 ohms is indicated rather than the ultra-low value of 25,000 ohms as currently specified in NFPA No. 56. The Committee is urged to consider raising its specified lower resistance limit to the recommended safe value of 250,000 ohms for inclusion in the next issue of NFPA No. 56. Until such changes or others, if any, are made, the recommendations as therein currently

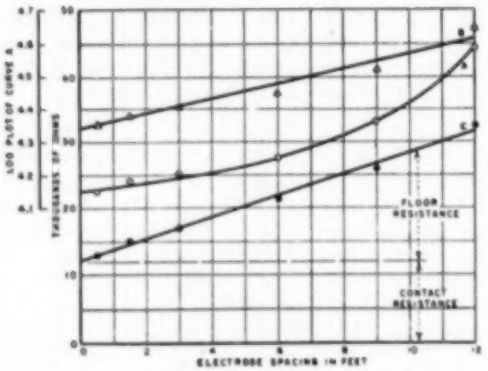


Figure 2. Curve A illustrates the composite resistance of a conductive linoleum floor and the electrode contacts with the floor in terms of electrode spacing, as measured by the NFPA method. Curve C shows the actual decimated linear resistance of the same floor, separated from the reduced and constant contact resistance, as measured with conductive paste applied to the bearing faces of the electrodes.

contained in NFPA No. 56 remain the authoritative directives.*

If a contemplated new floor for an anesthetizing area were specified to possess a resistance when laid ranging from 400,000 and 600,000 ohms, which is a happy median of the present recommended resistance limits, the interests of safety would be served in an admirable manner. Not only would such a floor safeguard the electric hazards of potential shocks to personnel and arc ignition of flammable mixtures, both resulting from faulty electric cables or appliances, but also, it would discharge static electricity as rapidly as it is generated on the floor, floor-borne equipment, or personnel.

Such a proposed installation of flooring would provide such a high degree of electrical safeguard as to render unnecessary the expense of installing and maintaining a separate ungrounded electrical distribution by the use of isolating transformers with their controls and signals, as recommended in the NFPA No. 56 on the basis of the 25,000-ohm minimum resistance limit.*

Figure 2 shows by curve A the combined values of the actual floor resistance and the high, non-linear, contact resistance of the standard test electrodes with the floor, when the resistance of conductive linoleum flooring is measured by the recommended NFPA method. Curve C, on the other hand, depicts the linearity of the actual floor resistance with spacing between electrodes, as well as the segregation of the overwhelming contact resistance, when measurements are made by the author's method of applying appropriate conductive paste to the bearing faces of the electrodes.

*See Ed. note on page 119.

SAFETY PREREQUISITES OF PHYSICAL FACILITIES

The essential and sundry facilities in anesthetizing areas which form the integrated physical framework basic to safe working conditions for eliminating electrostatic explosions comprise: (1) moderately conductive floors; (2) all floor-borne portable equipment, including various auxiliary and specialized medical and electrosurgical apparatus; (3) electrical distribution control, outlet, and lighting units; and (4) grounded facilities, such as radiators, water outlets, non-current-carrying metal parts of electrical equipment, and the like.

(1) Conductive Floors. The safest and best floors for hazardous locations possess certain definite and desired qualities among which are: (A) continuous and homogeneous composition to maintain everywhere on the floor its electrical resistance within the recommended limits and to contain no cracks as between tiles of all types and squares of terrazzo for the absorption of conductive liquids and dirt; (B) an appropriate color to avoid distracting and hazardous reflections and to encourage unrelenting cleanliness from such collections as insulating dusts, powders, suture clippings, broken pieces of glass ampules, and others; (C) de-glossed surfaces to prevent slipping and its consequential electrostatic potentialities, as well as injuries to personnel; (D) resistance to deterioration from normal wear and tear and from chemical cleaning agents; (E) resilient composition which, under no circumstances, will cause percussion sparks when tempered steel instruments or portable steel equipment strikes the floor; and (F) electrical resistance between any area of the floor and ground, as measured by the NFPA method, not less than 250,000 ohms in order to provide safety from electric shock and electric arcs by defective electric cables or equipment.

(2) Floor-Borne Portable Equipment. Such equipment, if heavy, is provided for portability with rubber casters or metal skids and, if light-weight, as for stools, it is pushed or lifted about, the leg tips are either of bare metal or encased in rubber caps.

The prerequisites for safe operation of all floor-borne portable equipment comprise the following: (A) All parts of portable equipment must be electrically conductive by being constructed of metal, except for those parts where conductive rubber is required, as in casters, leg tips, or flexible accoutrements, such as the tubing, breathing bag, and face mask of anesthesia machines; (B) all rubber parts of any operating-room equipment should be conductive and all such products should be acceptance-tested on delivery by measuring their conductivity with the test-kit ohmmeter, as some hospital suppliers have been extremely and culpably negligent with regard to conductive-rubber items; (C) the electrical contact resistance of each portable unit to floor, through the conductive-rubber casters or leg tips, should be measured with the ohmmeter and, if it exceeds the safe upper resistance limit, as it commonly does, such high resistance introduces grave electrostatic hazards and, since drag chains of all types on portable units are ineffectual or even a menace to safety, this dangerous situation may be remedied by the use of a resistance-controlled grounding device soon to be placed on the market; (D) anesthesia machines can be death-deal-

ing units unless they are maintained in perfect condition at all times, tested for leaks before every operation, equipped only with conductive rubber parts throughout, cleaned of partly used containers of ether after each day's service, and manipulated during operating periods with utmost care not to cause spurts of high-pressure gas from cylinders; (E) electromedical and electrosurgical units, if they must be used, should if possible be employed with nonflammable anesthetics, and, in any event, the instruments should be thoroughly tested before service in a safe location for perfection of operation, inspecting, and testing them with the ohmmeter for satisfactory insulation of all electrical parts and especially of the electric cable which should be long enough to reach wall outlets without use of an extension cord; (F) universal or direct-current electric motors with their sparking commutators are particularly hazardous units in flammable areas and, when motors must be used, they should be located as far from the patient's head as possible and the higher they are placed above the floor the safer—several feet being recommended in either instance, and it is germane to state here that the National Electric Code prescribes only explosion-proof motors for use in hazardous locations; (G) since the operating table, even as the anesthesia machine, is another focal center for potential explosion hazards, the table should be meticulously inspected and tested by the ohmmeter to determine that all coverings are conductive and, in addition, a wide ribbon of conductive rubber secured to the metal of the grounded table should be available for contacting at all times the bare skin of the patient or by other appropriate means to assure discharge of any transient electrostatic accumulations; (H) although a distance of two feet from an orifice leaking flammable vapor in amounts used in anesthetizing applications is considered safe from possible explosion hazards according to NFPA No. 56 by virtue of presumed vapor dilution with the surrounding air, cohesive influences are known sometimes to carry wisps of flammable vapors, like a powder fuse strewn along the ground, surprising distances, and, hence, this two-foot recommendation should be considered a fallible, or at best an indicative, minimum.

3—Electrical Distribution. In providing electrical facilities, extreme precautions should be observed in the following divisions: (A) the installation of all electrical circuits, their controls, receptacle outlets, switches, and stationary wall-mounted equipment shall conform with the recommendations of NFPA No. 56 and the requirements of the National Electric Code for hazardous locations in explosive atmospheres; (B) connections of portable electrical appliances to receptacle outlets should be made before anesthetizing procedures have started, where this is feasible, in order to preclude potential sparking and explosion hazards; (C) keep electric cords and electric appliances of all types, either those located on the floor or contained in cabinets, away from contact with or exposure to conductive liquids for the purpose of avoiding possible ignition of flammable mixtures by electric arcs resulting from short circuits; (D) where 8-volt circuits energize low-voltage specialized electrical facilities, ignition hazards from sparks of switches, loose connections, or defec-

tive equipment are fully as realistic and probable as for conventional 125-volt systems; and (E) polarized plugs and wall outlets should always be provided for equipment utilizing different than standard voltage for either DC or AC service.

4—Grounded Facilities. This phase of safety relating to grounded facilities is one of most significant importance throughout operating rooms in guarding against potential ventricular-fibrillating types of electrocution from 125-volt distribution; and safety here is considered under the following items: (A) the fortuitous interests of safety are most effectively served in a ground-insulated area, such as the floor of an operating room provided with a quarter megohm or more of resistance to ground, by excluding from the area all ground-type hazards—a widely recognized safe practice regardless of whether the electrical distribution utilizes the ungrounded system, as advocated by NFPA No. 56, or the conventional grounded system; (B) based on the use of flooring moderately insulated from ground, as specified in A, therefore, the frames and exterior metal housings of electrical equipment in operating rooms provide maximum protection from possible shock and arc ignition when they are not grounded; and (C) similarly, therefore, radiators, steam or water pipes, and lavatory facilities in operating rooms which all comprise excellent grounds constitute grave electrocution hazards, unless these grounded facilities are appropriately protected by glass or insulating barriers to prevent bodily contact with them while one is holding or manipulating electrical equipment which is or becomes defective.

NFPA NO. 56—HOSPITAL SAFETY GUIDE AND BIBLE

The recommendations for safe practices within hospital operating rooms in NFPA No. 56 are logically classified and impressively displayed, clearly and forcefully expressed, and the many paragraphs relating to static electricity, its hazards and controls, comprise an excellent, abbreviated, and specialized text on this subject. Each surgeon, doctor, anesthetist, and nurse serving together as an operating team should possess a copy of this pamphlet of safe practice. Each would do well and should be expected to study it thoroughly and to re-read it frequently, underscoring for emphasis and quick reference those parts which relate particularly to his or her specific duties.

When all of the physical facilities and safeguards, as recommended, are installed and scrupulously maintained throughout anesthetizing areas, the physical framework for safe working conditions is provided.

However, the human element through its sins of commission and omission, even though motivated by the most commendable interest and diligent desire to serve effectively and well, nevertheless unwittingly and in blind ignorance may devastate safety measures. Thus, by ill-advised and thoughtless acts, all members of the operating team and the patient may be subjected to electrostatic explosions, possibly resulting in dire consequences.

The last recommendation in NFPA No. 56, under the heading REGULATIONS, cites the priceless tenet relating to responsibility for upholding precautionary measures in anesthetizing locations directed toward preserving safety in all of its many phases. This key regulation states—"It

shall be the responsibility of the anesthetist (or the person appointed by the hospital authority to act in that capacity) to enforce the above regulations."

Unless the lines of authority among the personnel of an operating team are clearly delineated, recognized, and respected, little or no worthy progress may be anticipated in resolving to practice safe techniques in hazardous areas and in imparting by instruction and supervised practice the basic principles on which adequate safeguards are founded.

The anesthesiologist or operating room supervisor is a logical representative of the hospital administration to be charged with full authority to maintain the inviolate tenets of a developed safety program throughout the extent of his or her jurisdiction. In turn, the supervisor would delegate responsibility and authority to a nurse or anesthetist, who is competently trained and qualified in all safety techniques and practices, in each room where anesthetizing services are administered.

The FOREWORD of NFPA No. 56 records in direct, unequivocal, and impressive language the purpose and the applied philosophy of its recommended pamphlet of interdependent standards for attaining safety from explosions in hospital operating suites. And attention is directed to the significant statement made there that the electrical recommendations are minimum requirements.

Apropos of the plea in this paper for an organized program of specific training in the principles and practice of operating-room safety, the FOREWORD states—"To approach complete success in the prevention of anesthetic explosions, all persons — the surgical staff, the nursing staff, the maintenance staff and administrative personnel —must be educated and periodically reminded of the explosive nature of combustible anesthetic agents." Recognizing that education is one function and training quite another, NFPA could enhance this significant statement to inestimable value by strongly recommending organized training and practice in safety techniques to be required of all operating-room personnel.

SAFETY PRESCRIPTIONS FOR OPERATING TEAMS

The anesthesiologist or operating room supervisor and the delegated appointees for each operating team, who, quite appropriately, might be the anesthetists, should be well qualified in the required safety practices relating to the services expected of each member of the operating-room personnel. And as already mentioned, the authority vested in each such representative of the anesthesiologist or operating room supervisor should be recognized and accepted as final in all matters relating to safety by virtue of her qualifications of knowledge and leadership. Her authority and her responsibilities in directing safe operating room practices should be vigorously and loyally supported, as long as she retains her appointment, both by her supervisor and the hospital administration.

No exponent of safety in applying its doctrines and practices is expected to possess the virtues of perfection. But the person responsible for safety in anesthetizing areas should be reasonably well qualified in safety principles, codes and practices, possess the inquiring student approach to learning, have the inspiring qualities of leadership through which to encourage others in acquiring

interest and knowledge related to their specific duties, and by the radiation of sincerity and genuine interest present a helpful and friendly attitude of cooperation in dealing with operating-team associates rather than displaying critical reserve.

In hazardous anesthetizing locations, the recommended safety practices for operating teams may be classified into the several following categories: (1) posted safety regulations; (2) safety clothing of personnel; (3) safety at the anesthesia machine; (4) precautions around the operating table; (5) pre-operative safety measures; (6) safety housekeeping; and (7) safety training and practice aids.

1—Posted Safety Regulations. Conspicuous, large-print, safety regulations, posted at the entrances of corridors to operating suites, are impressive and may be important but their safety value is only commensurate with the degree to which the regulations are respected and practiced.

If a regulation prescribes the donning of scrub clothes and conductive footgear before entering the hazardous location, obviously adjacent dressing rooms and an assortment of sterile conductive clothes should be available for making convenient and quick changes to safety attire before entering the corridor to the operating suites.

If measuring the electrical conductivity of footgear is prescribed as a regulation, the conductometer on which one stands for the test should be located conspicuously beside the entrance to the corridor and provided with a recording form for registering name, test result, date, and time. An inverted wire-bristle brush secured to the floor adjacent to the conductometer is commonly utilized as a facility for readily cleaning the soles of the conductive footgear, if necessary.

A posted regulation that no lighted cigarettes, cigars, or pipes be allowed in the operating-room area should be an inviolate dictum of every hospital.

Posting only those essential safety regulations which are indispensable can be enforced while too many regulations, thus comprising a substantial code, are impractical and beyond enforcement. While true that safety cannot be legislated into practice, regulations of a reasonable number and nature, on the other hand, serve an educational purpose as well as a controlling restraint. To see that safety regulations are respected might well be the responsibility of operating room supervisors or others whose authority would not be challenged.

2—Safety Clothing. Precautionary measures relating to the type of clothing prescribed for the safety of those in anesthetizing locations are simple and direct—use only cotton scrub clothes throughout, cotton stockings, and conductive footgear.

Violations of this safety requirement in hazardous areas of industry, resulting in gruesome injuries and disfigurements, have proved beyond doubt the wisdom of adhering rigorously to the use of safety clothing from head to toe.

Such violations of prescribed safety regulations are sometimes referred to in really polite language as "relaxation of a safety regulation"; but, regardless of the subtle discriminations of terminology, physical disfigure-

ments, loss of limbs, or deaths are high prices to pay for trying to disprove a safety tenet which the hard school of experience has prompted.

3—Safety at the Anesthesia Machine. The anesthesia machine is the most hazardous focal center within each anesthetizing location where, like a carburetor of an automobile, flammable mixtures are created. This significant difference is to be noted—that oxygen mixtures within anesthesia machines may be ignited by a hundredth of the spark energy required for air mixtures from carburetors. No escape of flammable mixture from the anesthesia machine or the face mask of the patient should be permitted during an operation.

The anesthetist should be certain of and well practiced in the safe techniques of this service; and, if required to rise even slightly from the stool, always first the anesthetist should grasp the metal of the operating table in order to discharge most quickly whatever electrostatic transient potential, if any, exists. Assuming specified NFPA flooring and proper intercoupling facilities, no more hazardous practice could be used than draping wet towels or sheets, or allowing conductive liquid, around the base of the anesthesia machine and its contiguous floor.

The spurting of gases from cylinders by improper valve manipulations is dangerous and should be avoided. The slipping of the hand over or from the re-breathing bag while manipulating it is also extremely dangerous, and similarly, spiral inhaler tubes and the face mask should be handled with slow and deliberate movements while administering anesthesia. The practice of internally or externally wetting the breathing tubes and bag in preparation for administering anesthesia is particularly dangerous as it forms additional capacitor elements for inducing electrostatic sparks. No one other than the anesthetist should be allowed close enough to the anesthesia machine or any of its parts inadvertently to touch them.

Electrical appliances of all types and their electric cords should be kept well away from the anesthetizing area. All anesthetizing gases and vapors except ethylene range from 45 percent to 141 percent heavier than air, thus form leaks rapidly falling to and spreading over the floor; and, of course, ether, being a liquid, is especially dangerous if spilled, as it volatilizes rapidly into large vapor volumes. Ethylene, being slightly lighter than air, causes flammable hazards in upper strata of space above the patient.

4—Precautions Around Operating Tables. The area of and around the operating table is a close second to the anesthesia machine in the claim of distinction for the most hazardous location in an operating room. Here safety from a potential explosion is vitally dependent on the fit of the face mask in reducing to nil the leakage of anesthesia flammable mixtures.

Ventilation effectively applied around the patient's head, neck, and chest is the only way to scavenge whatever small gas leakage may occur—ventilating at this location by use of a probing exhaust hose attached from a suction pump or possibly from the anesthesia machine. If moistened cotton draping can be tolerated around the neck and head area, the values of this technique lie in avoiding hazardous pockets for the accumulation of anesthesia mixtures, in providing a conductive area to protect against igniting sparks near the face, and in protecting the chest, neck,

and head areas against serious burns in case of a flash fire.

When an endotracheal breathing tube is used with inflated cuff, it serves a most effective flame arrester, especially with the contiguous moist wall of the trachea, in preventing a flash fire near the face from back-firing the flammable mixture in the lungs, thus causing an explosion.

The surgeons or nurses, after leaning over the operating table, thus increasing its capacitor effect, should acquire the infallible habit of straightening up and of performing all other such acts of motion with deliberate slowness. Also it is most important for them to keep as far away from the head of the table and from the anesthesia machine as possible, and especially while straightening up. If these precautions are not observed, an alternative seems to be the use of clumsy intercouplers attached from the doctors and scrub nurses to the table. These technics are most important in avoiding the rapid rise of a transient potential and an induced spark should electrification of the individuals or the operating table exist.

Doubtless no act at the operating table is so surcharged with hazardous potentialities as that so commonly practiced of flipping cotton sheets onto the operating table or of stripping any type of coverings from the table. Sterilized dry cotton sheets, as used in operating rooms, unfortunately possess electrical resistance within the critical range where they can readily electrify by contact with the ether screen or other charge-producing facilities. Thus, the flipped sheet may yield a spark by touching the patient's face or nearby metal parts and, by sparking, may provide the source of ignition for a flash fire and, possibly, for an explosion.

In order to avoid electrostatic sparks in handling cotton sheets at operating tables and other coverings as well, flipping and stripping practices in applying or removing table coverings should be substituted by a technique of deliberate slow motion and, as much as possible, of avoidance in contacting intermediate facilities above or around the operating table. In this regard, a relatively safe technique, as now used in some hospitals and designed to prevent the dangerous practice of flipping sheets with its concurrent spark hazards, consists of a special folding method whereby the sheets can only be opened out manually and not by flipping.

The writer has performed many hundreds of tests on variously conditioned sample strips of operating-room sheets, in order to determine how readily they electrified and how to render them reasonably safe. All samples were prepared 2-inches wide and 16-inches long, with 12 inches provided between the test electrodes. The direct-current voltage applied to each sample under measurement was exactly 500 volts. The ohmmeter could measure their high resistances within 5 percent precision by the use of any one of five scales to a maximum of 20,000,000 megohms. The measurements were made under a number of realistic conditions such as dryness after sterilizing the samples, varying humidities from 37 percent to 93 percent, definite moisture content, and finally treating the samples successively with different percentages of three well-known antistatic agents for modifying the conductivity of the sheets, measuring the samples after appropriate sterilizing and drying.

The results of these important tests, adjusted to a common starting ordinate as displayed graphically in Figure 3, yield several highly significant conclusions. An inspection of the data discloses that antistatic agents A and B possess generally similar trends in lowering the resistance of dry, untreated, cotton sheets, although product A is seen to be appreciably more effective in this respect than product B, as it reduces the resistance of the sample strips from 723,000 megohms to 42,000 megohms which is a large over-all decrease of 1.42 decades, thus rendering an entire treated sheet reasonably safe.

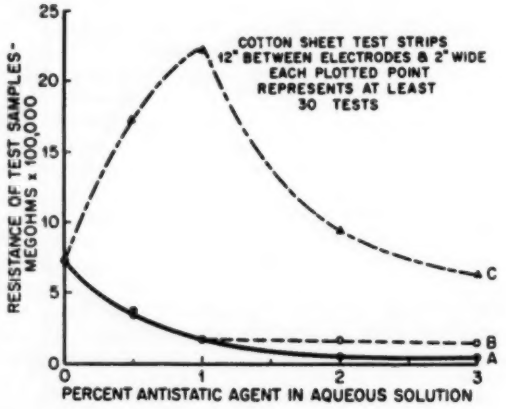


Fig. 3. Curve C illustrates the desirable properties of antistatic agent A in decreasing the electrical resistance to where the electrifiability of cotton sheeting is reduced practically to nil. Antistatic B is not as favorable in this respect as product A. So-called antistatic C at the crest of Curve C renders the treated cotton test strips almost as electrifyable as nylon and at its best is no better than untreated dry cotton sheeting. Refer to text for these significant tests.

Attempts at electrifying the sheet samples, treated with a 2-percent solution of product A, yielded practically no generation of static electricity, and product A in this regard was quite superior to product B. The plain dry sterilized sheet samples could be made to generate considerable static electricity and, also, it dissipated the electrification with relative slowness.

On the other hand, the sheet samples treated with a 1-percent solution of antistatic product C produced relatively high electrification; and, with a 3-percent treatment, the electrification was quite generally about that for the dry samples. Product C rendered the electrification of the samples at low percentage conditioning greatly more than for the dry samples, thus rendering the samples considerably worse, hazardwise, rather than better.

Hence the configuration of each resistance graph in Figure 3 indicates in a qualitative manner the electrifiability of the samples treated with the antistatic products as compared to the dry untreated samples. The relative humidity during tests on the samples which were conditioned with the three antistatic products was in the order of 50 percent.

These tests disclose that the use of a really effective antistatic agent, introduced into the final rinsing process

during the washing of cotton goods for operating rooms, merits serious consideration in the control of static electricity and its spark-ignition hazards. Fortunately the cost of such antistatic pre-conditioning of operating-room sheets during each laundering is insignificant.

However. the importance cannot be overemphasized of selecting an antistatic agent from the many marketed products which is most effective in rendering operating-room sheets safely conductive. The selection of these antistatic products by hospital purchasing agents should be based on authenticated data submitted by the manufacturers of a similar nature to that shown in Figure 3.

5—Pre-Operative Safety Measures. In order to obtain safety in all of its fullest blessing during operative surgery, every safety measure should be anticipated, planned, and provided. The safety provisions include items of the type herein explained.

Make appropriate check tests for the operating perfection of all equipment to be used or even anticipated for use during surgery, being most critical of those units that utilize electrical energy in any of its several forms.

Examine and test electric cords or cables, making sure no fraying, abrasions, breaks, or defects exist in the insulation.

Connect all electrical equipment to the outlets and switch on the units before the anesthesia machine is operated, thus to avoid any possible electric sparking within the hazardous areas.

Humidify the hazardous areas from a minimum of 60 percent to 75 percent, or preferably more, which provision, although an undependable and dubious factor in its alleged function of bleeding off static electricity by surface conduction, is sometimes effective in preventing electrostatic sparks.

Don all rubber gloves which have applications of talc or other insulating powders applied to them at a location in the operating room as far removed as possible from around the operating table, thus preserving the safety of conductive intercoupling of flooring, footgear, and casters or leg tips of portable equipment throughout the main working area of the operating room.

6—Safety Housekeeping. Cleanliness, tidiness, and orderly arrangement of facilities in operating rooms are essential guide posts to safety practices relating to control of explosion hazards.

In dirty locations for hospitals, hazardous locations should be kept free of dust and smoke even if costly air conditioning of operating rooms becomes necessary.

No equipment in hazardous locations, and especially anesthesia machines, should be covered during their periods of non-use, since flammable mixtures may thus accumulate and invite potential explosion hazards.

Floors should be maintained immaculately clean at all times by washing them frequently with appropriate detergents to remove hazardous insulating coatings which destroy their desired conductive properties. No waxing should ever be applied to floors, although reputable floor preservatives which have been specially developed to help maintain conductivity may be used, as desired.

Slipping on polished or wet floors from improper maintenance may instantly destroy the value of otherwise carefully planned safety precautions by dislocating a face

mask or the inhaler tubes, causing efflux of flammable mixtures just where an inadvertent electrostatic spark might be generated by the sudden and quick act of slipping. Hence, non-skid surfacing of floors may contribute immeasurable value in preventing such catastrophes.

7—Safety Training and Practice Aids. Beyond and in addition to the provision of every desirable physical facility in a hazardous location, safety from electrostatic explosions—a worthy reward of diligently acquired human behavior—may be attained in commensurate relation as the operating-room personnel devote their studied efforts to acquire safe techniques in every division of their activities by appropriate training and practice.

Electrostatic hazards and their potentially dire consequences throughout anesthetizing areas must not be considered by hospital administrators an inevitable risk in the art of surgery by an operating team. Such a belief would proclaim an attitude of defeatism quite unworthy of progressive people. All electrostatic hazards, regardless of their origins or modes of expression, can be controlled to their virtual elimination. The concluding paragraphs of this paper are devoted to pointing the way to the achievement of such successful attainments through safety training and practice aids.

Each member of an operating team should be urged and encouraged to keep and classify notes relating to all phases of static electricity, its hazards, its controls, and its relationship to daily activities in the operating room. Note unusual happenings and observations relating to static electricity of one's own or others' experiences, jotting them down for filing as invaluable memoranda during later study and perusal.

Keep for reference all newspaper clippings and articles from magazines and periodicals of those problems, situations, or disasters which result from electrostatic causes, as they frequently are most helpful, be they from happenings in industry, transportation, homes, or hospitals.

Many valuable papers are published each year on electrostatic subjects relating more or less closely to problems like those encountered by operating-room personnel. The authors quite generally have reprints available which may be obtained by request. Some particularly germane and significant contributions to the electrostatic literature not otherwise available may be obtained by photostatic reproduction at libraries through small token charges which hospitals should be most willing to defray through interests of safety in their own well-being. A specialized library of such pertinent literature for the benefit of the surgeons, anesthetists, and nurses, maintained as a part of the anesthesia department, would constitute a valuable incentive and contribution to safety instruction, training, and practice.

INSTRUCTION SHOULD BE AVAILABLE

For the edification and encouragement of each member of the hospital's surgery teams in whose keeping, knowledge, and care rest its bulwark of safety from the tragedies of explosions and from unfavorable and injurious publicity, appropriate facilities for instruction in electrostatic safeguards should be made conveniently available by the hospital authorities. The cost of the necessary

facilities for such instructional aids is quite insignificant, while the beneficial returns from the small investment may yield the difference between life and death and the assurance by the staff of safety through knowledge.

The recommended facilities which every hospital should provide for the instructional aid of its operating-room personnel comprise the following simple, rugged, and essential equipment: (1) a 3,000-volt electrostatic voltmeter for measuring the voltages created by flipping sheets, by handling the detached rubber parts of an anesthesia machine, by the quick motions of arising from stools, etc.; (2) an electronic electrometer by which contact electrification and its variations may be demonstrated by using samples of materials common to operating rooms; (3) an NFPA standard test kit for measuring floor resistance, contact resistance of portable equipment with the floor, the effects of uncleanly dispersions on floors, and the like; (4) a conductometer for testing the resistance of footgear under the many conditions which exist in practice; and (5) a portable hospital-type staticator with probe for exploring the potentials of dangerous acts in the everyday variety of operating room techniques. The cost of the first four instruments totals less than $400, while the staticator is about $330. A group photograph of these instruments is shown in Figure 4.

Other test facilities may be picked up for little or nothing, such as an 18" rod of stainless steel, chromium-plated steel, aluminum, brass, glass, and plexiglas and, also, a 5" by 15" fabric sample of cotton, linen, wool, silk, rayon, sharkskin, nylon, orlon, dacron, dynel, rubber, conductive rubber, and others.

All of these testing facilities—the instruments and test samples—should be available to any nurse, anesthetist, or surgeon of operating teams and their use encouraged whenever the personnel find a few minutes on or off duty to experiment. Thus, they may individually or in groups acquire the knowledge, experience, and practice relating to generating static electricity and to controlling it. The equipment might well be consigned by the hospital administrator into the custody of the operating room supervisor or the chief anesthetist, either or both of whom could to advantage give special demonstration lectures to groups of nurses, anesthetists, and doctors, from time to time, as class sessions.

INSTRUCTION AIDS RECOMMENDED

Apropos of these demonstration lectures and experimental studies, as recommended above, the American Hospital Association or the American Association of Nurse Anesthetists or other such agencies and affiliates, could most appropriately sponsor such outstanding instructional aids as the two recommendations described in the following paragraphs. These instructional aids could be made available to all hospitals and, thereby, would provide immeasurably valuable and significant contributions to promulgating operating room safety.

One of the authoritative agencies helping to contribute to a clearer understanding of static electricity, its generation, hazards, and controls, in hospital operating rooms is the U. S. Bureau of Mines in Pittsburgh, Pa., through the auspices of Mr. Paul G. Guest and his associates. Mr. Guest on those occasions approved by the Bureau has de-

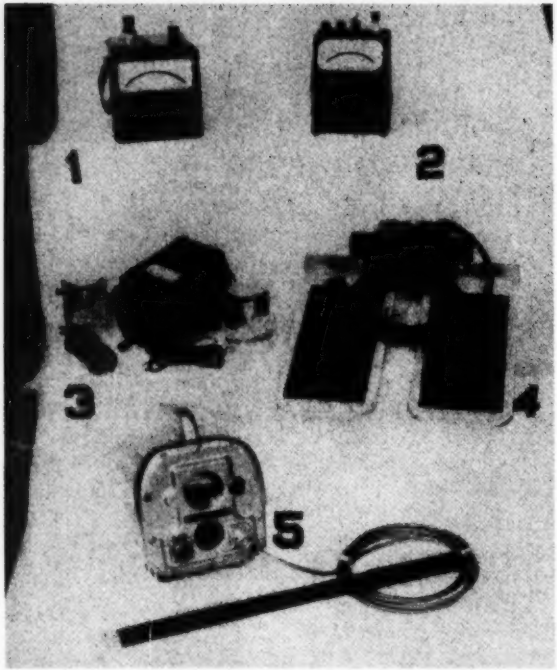


Figure 4. The five instruments here displayed and numbered, and described in the text, are essential to a program of experimental study and instruction relating to the generation of static electricity and to its control in eliminating spark ignition which causes potential explosion hazards.

livered a most instructional and illuminating lecture on operating room electrostatic hazards and controls, supplemented by a wealth of clarifying demonstrations using elaborate and especially constructed equipment for the purpose.

The writer first proposes the recommendation that some one of the above-mentioned associations or agencies, interested in promoting instructional benefactions to operating-room personnel, negotiate with the U. S. Bureau of Mines for making a color sound film of Mr. Guest's demonstration lecture with many film prints available, on schedule, for distribution to and use by all hospitals. This suggested plan offers the only practical means whereby the many thousands of nurses, anesthetists, and doctors who are so widely scattered throughout the country may be given the privilege and advantages, not only once but many times if they wish, of seeing this program of authoritative demonstrations on electrostatic hazards and controls. From it each may pattern his or her own study of the vital subject by virtue of the physical aid of the experimental equipment recommended above and shown in Figure 4.

The writer also proposes the recommendation that some one of the above-mentioned associations or appropriate agency could effectively serve the instructional needs of operating-room personnel by organizing and conducting intensive courses, including laboratory practice, on safety from electrostatic explosions in hospital operating rooms. These courses should be given by a team of specially experienced and trained teaching experts in the subject. The classes could be scheduled successively at many convenient locations throughout the country, thus providing minimum

travel time and expense for those attending, as well as affording this invaluable opportunity and privilege of safety instruction to operating-room personnel in practically every hospital in the country. Hence each year hospitals could send representatives from their corps of anesthetists, operating room supervisors, anesthesiologists, and surgeons. Such training, including laboratory instruction on generating and controlling static electricity as it occurs in operating rooms, would stimulate interest and desire in each class member to pass along this knowledge to associates in their respective hospitals. In this manner, safety in the operating room would be given the recognition, importance, and status it deserves.

SAFETY TRAINING PAYS ITS OWN DIVIDENDS

An operating room with its operating team in action is either safe or not safe—it cannot be half safe. Hence, for safety training and practice to really succeed in its fullest measure, it must be given an all-out, continuous, and unrelenting effort.

In the interests of the hospitalized public, as well as the welfare of hospital personnel, safety principles and practices relating to electrostatic hazards, as they apply to the day-by-day performance of surgical teams in operating rooms, should be inculcated on the nurses, anesthetists, and doctors by the most modern instructional methods and through the best informational channels currently available.

When this pioneering spirit of adventure into safety training is encouraged, accepted, and diligently put to work by hospital personnel serving in hazardous areas, occurrences of dangerous flash fires and devastating explosions will practically reach the vanishing point.

As a priceless and intrinsic by-product of an intensive program of meticulous and specialized training in electrostatic safety, it inevitably reflects itself auspiciously into all other domains of safety services within operating rooms. The fully awakened receptive attitude of the personnel toward attaining the goal of success becomes its own reward by achieving other worthy advances in the art of improved safe operating-room practices.

ED. NOTE: While the author makes recommendations for changes in NFPA Bulletin 56, he wishes to emphasize that until changes, if any, are made, it is "the hospital's Bible" and should be followed religiously. Recommendations for changes in the code are his own.

ACKNOWLEDGMENTS

In obtaining the extensive electrostatic data of which Figure 4 depicts a part, the author expresses his appreciation of the cooperation given him by the Herman H. Sticht Co., New York City, and the American Sterilizer Co., Erie, Pa., in providing essential specialized instruments and equipment.

Also he is indebted for the critical reading of the manuscript and suggestions to the several especially qualified individuals in the following organizations within the Metropolitan New York area: Herman H. Sticht Co.; Brooklyn Veterans' Hospital; Kings County Hospital; The New York Hospital; Long Island College Hospital; and St. Clare's Hospital.

ICS Holds Three-Day Meeting for O.R. Nurses

● Over 730 operating room nurses attended the special sessions held for them during the International College of Surgeons meeting in New York City and sponsored by the College. Those present at the three-day session came from 22 states, Canada, and Turkey. On the following pages is a report of the meeting.

Planned Clinical Instruction—Panel Discussion

Moderator: Mary E. Muller, R.N., Assistant Director, Nursing Education and Nursing Service, Department of Hospitals, New York.

Participants: Grace E. Marr, R.N., Assistant Secretary, Inter-group Relations Program, ANA; Gladys Scott, R.N., Assistant Director, Nursing Education, Beth-Israel Hospital School of Nursing, New York; W. Mason Couper, M.D., Lecturer in Surgery, McGill University, Assistant Surgeon, Royal Victoria Hospital, Consulting Surgeon, Queen Mary Veterans Hospital, Montreal, Que.; Edith Fallon, R.N., former ORS, University Hospital, New York; Elsie Palmer, R.N., Assistant Director of Nursing Care, Bellevue Hospital, New York, and Hilda Mazerall, R.N., Instructor in O.R. Principles, Winnipeg General Hospital, Winnipeg, Manitoba.

Miss Mullen—This is a timely subject. In some schools thought and experimentation have gone into changing curriculum. Eliminating O.R. technic courses in student curriculum is the new trend.

Miss Palmer—It is difficult to evaluate any new trend without trial. Many feel that O.R. experience is necessary. In the O.R. the keynote is asepsis and nowhere can the student learn this so well. At least 15 more classroom hours would be needed to justify its removal. In the O.R. the student learns, understands, and appreciates teamwork and develops a broad understanding of total patient care. Some question the practicability of O.R. experience. They ask, "Is it a learning experience?" or "Is it an endurance test?" They also ask, "What does the student learn that she can adapt to other areas of patient care if she is not to become a supervisor in the O.R.?"

Miss Marr—We should first decide what it is that we want a student to be able to do when she graduates. Also we must decide how each aspect of the curriculum should be worked out to achieve a high caliber of graduate nurse.

Miss Scott—Our goals should determine the setup of the curriculum. Perhaps we can develop a philosophy in training students. Students should be brought into the planning stage so that we may profit from their valuable suggestions.

Mrs. Mazerall—The clinical instructor has the closest contact with the student. She should be able to discover the student's feeling and realize her needs.

Dr. Couper—Do not remove O.R. technic classes from the curriculum. I would regret changes which would alter the balance. We must retain clinical instruction in the curriculum. This background work is most essential.

Miss Mullen—Are the mechanical aspects of "scrub-

bing" a necessary part of the O.R. course?

Dr. Couper—This is a revolutionary period in modern medicine. "Scrubbing" aspect has been stressed beyond reason. We forget that we are dealing with people.

Miss Palmer—The O.R. will not be able to function without professional nurses. Is it right to use graduate nurses to do mechanical duties when we have a shortage of nurses?

Conclusion: If O.R. training were made an elective in the training course, most students would take it.

Miss Mullen—What are your feelings about technicians in the O.R.?

Mrs. Fallon—I have learned that these people can do very good work and relieve us of many of the routine chores which occupy our time. We nurses, however, have a fear that the technician will replace us. They can be a great help if you can condition your staff that these people are there to help and not replace.

Dr. Couper—The fear of replacement is needless among nurses. We must get "wise" to ourselves and realize that technical knowledge is not enough.

Question Period

Q. How many hours of theoretical instruction are necessary?

A. We must be guided by our state board groups. They are making plans on what the student should have, but are not setting up specific hours—it is left to the clinical instructor to decide.

Q. What are the duties of the clinical instructor?

A. Instructor must be the stabilizing person and she is the one who can help the student in learning. She can benefit by farming out teaching technics to other supervisors. What is important is that teaching must be consistent.

Q. Who should teach the student in the O.R.—one instructor or many in the specialties?

A. You need one person as a director. However, every nurse in the O.R. is a teacher. You must be a teacher if you are a scrub nurse or a supervisor.

Q. Where does the circulating nurse fit into the curriculum?

A. This is an important job. If she knows her job and has all the qualifications, she can direct almost all activities in the room. If an emergency arises, the circulating nurse is the one who must be prepared.

Q. At what period should she receive her training?

A. Usually toward the end of the first year and beginning of the second. What does she need to know before she goes into the O.R. in order to reap the most benefit from her training—this should govern the placement of training. She needs orientation in physiology, sociology, and microbiology.

Q. How much time does the present curriculum allow?

A. Traditionally eight weeks. But this depends on the state you are in.

Sterilization and Aseptic Technic

W. Mason Couper, M.D., Montreal—It is important to develop an "aseptic conscience" in an operating room nurse. Standardization of procedures is worthwhile because it is a time-saver, but the hazard involved is that of routinizing and making monotonous the daily job of the nurse.

In operating room work it is often undesirable to move

a person well trained in one job into another—i.e., a good scrub nurse should be allowed to remain so and not be pushed into the position of supervisor where she has no talents at all. Development of skills is admirable, but in the operating room nurse, this is not enough. It is imperative that she develop wisdom as well.

Chemical Sterilization

Harry E. Morton, Sc.D., Professor of Bacteriology, University of Pennsylvania, School of Medicine, Department of Microbiology, Philadelphia—Different infecting agents demand different chemicals. I agree with Dr. Walter that chemical disinfection should be used only where other means are impossible. Steam should be used wherever possible. The nature of the instrument being disinfected is important. What kind of surface does it have? Bacteria lodge in pits and cervices and escape contact with disinfectant. Organisms lodge between metal surfaces. Some chemicals will dissolve markings on thermometers.

It is important to consider the contaminating organism. Spore formers are more resistant than vegetative bacteria. Sterilization after gas gangrene bacillus or in the presence of fecal material is difficult, and you cannot rely on a chemical disinfectant. Many chemicals do not affect the waxy tubercle bacillus. Pyrogenic infections are caused by different organisms. Chemicals act differently in the presence of gram positive or gram negative organisms.

It is also necessary to consider the nature of contamination. Many organisms are more difficult to destroy than a few. You cannot destroy a million as rapidly as 10. A 90 percent kill in 10 seconds is usual; more organisms take more time. Blood, pus, and sputum protect organisms.

Another factor to consider—is the material moist or dry? The time required for disinfection is also an important consideration.

When a disinfectant is tested in a test tube, a neutralizing agent should be used in the sub-culturing medium. The disinfecting agent will attach itself to the surface of the cell. If there is no kill, then a sub-culture should be done using a neutralizing agent. Use thyroglycollate for mercurials; a serum for G-11 and the quaternary ammonium compounds.

In considering a liquid vehicle, tinctures are safest because of the alcohol present. There is no skin disinfectant better than the alcohol solution in which it is contained. Iodine is a good bactericidal agent also.

Select a disinfecting agent for the job to be done. For tubercle bacillus, you need something especially active—a soapy solution of cresol or lysol. Disadvantages of these solutions are that they are not clear (you cannot see an instrument immersed) and the odor is objectionable.

Skin sterilization is impossible. The number of bacteria present can be reduced by using alcohol. Tr. Acrizine 1-200 has been found effective.

Question Period

Q. Would you comment on the effectiveness of Bard-Parker germicide as a sterilizing agent?

A. **Dr. Morton:** I tested Bard-Parker disinfectant several years ago. I think it is a fairly good disinfectant. The active ingredients are formalin and alcohol. The anti-rust agent added is generally thought to be sodium nitrite. Instruments can be left in the germicide indefinitely without rusting. It is effective in sterilizing sharp instruments,

but you must remember that spores take a long time to destroy. When they claim spores are killed in five minutes, I believe they are probably using a wet culture instead of dry spores. Don't forget blood, pus, and organic material protect organisms.

Q. What is the most acceptable way of sterilizing water? Tanks or flasks?

A. **Mr. Lermond:** You can sterilize water by either method. When water is introduced into the tanks, it is plain tap water. The tanks are fitted with filters which remove the gross dirt and keep the tanks clean. You will have sterile water after you sterilize for 30 minutes at 250°F, but you cannot keep it sterile. Tanks are supplied with air filters on top. When you remove two quarts of water, you suck in by negative pressure two quarts of air. If the air is contaminated, the water is contaminated. Water in a leaky valve will also contaminate a tank. If you can keep tanks clean and tight, you can keep water sterile.

Water in flasks, either distilled or tap, can be kept sterilized indefinitely. When heated in the sterilizer, all the air is driven off before the flask is sealed and a hermetic seal obtained. Sterility is maintained as long as the vacuum is maintained. Another advantage with flasks is that less water is used.

Q. How can you keep gloves from becoming tacky?

A. **Mr. Lermond:** Glove wrappers should be hydrated before being placed in the sterilizer. Do not preheat before placing in the sterilizer. Place glove in upper two-thirds of the sterilizer, taking care that the wrappers do not touch any metal in the sterilizer. Above all, if you wish to avoid tacking, allow glove to dry out and stay out of use for 48 hours after sterilizing.

Q. What is your opinion of formaldehyde cabinets?

A. **Dr. Morton:** I presume you have in mind sterilization by gas. This is a poor technic because the humidity must be controlled accurately. Gaseous sterilization, except for the use of ethylene oxide, is very risky.

Q. How is VASELINE Petroleum Jelly sterilized?

A. If the quantity is limited to one ounce of VASELINE or oil, the following exposure to dry heat is adequate for sterilization:

320° F.—1 hour
250° F.—4 hours

For larger quantities, the oils are exposed to saturated steam at 250° F. for 30 minutes; the steam to the chamber is turned off and they are exposed to dry heat at 250° F. for an additional four hours. The oils should be hydrated with 0.5 percent water before being placed in the sterilizer.

Q. Should all rings and nail polish be removed in the operating room?

A. Rings should be removed before scrubbing because bacteria which are protected by the band, escape removal and are likely to contaminate a patient's wound through a punctured glove.

Q. Is there any place for hydrogen peroxide in irrigating wounds?

A. Hydrogen peroxide is a very good disinfectant especially against organisms which are sensitive to oxygen. But when it is used to irrigate wounds, it must be remem-

bered that you are handling living body tissues and any chemical disinfectant is more injurious to tissue cells than to vegetative bacteria. You never irrigate a clean wound and in the case of an infected wound, it is much wiser to fight the infection with antibiotics from the inside than to irrigate and carry infection from the outside to the inside.

Q. Can instruments be kept closed when sterilized at 270° F. for three minutes?

A. No. They should be opened. There must be direct contact between steam and the locks and joints of an instrument to insure sterilization. When an instrument is placed in the sterilizer closed, these parts are only heated by conduction and the time for which they are left in the sterilizer is not sufficiently long for sterilization.

Q. Do you consider it good practice to use solutions from cans of catgut for disinfecting other articles?

A. The solution used in direct contact with sutures, the tubing fluid, is designed to exert its germicidal action over a long period of time and hence is not practical for other purposes. The solutions used for disinfecting suture tubes are often of a formalin composition and when these solutions are used for disinfecting other articles attention must be paid to the fact that the formalin will evaporate in an uncovered container, as well as the usual limitations of chemical disinfection.

Q. How do you feel about detergent germicides such as pHisoderm for skin disinfection?

A. The active ingredient in the detergent-germicides is hexachlorophene and it as such is not a disinfectant because when you expose organisms to it, they can be revived by culturing in the presence of serum or chemical neutralizers. They are good agents for scrubbing the skin but should not be used for chemical disinfection. They reduce the number of bacteria on the skin when used consistently. Surgeons who are interested in keeping the bacterial flora of their skin to a minimum, use these agents consistently. They are not sufficient for pre-operative disinfection of the skin of the operative field.

Q. Are ultra-violet lights effective in the operating room?

A. There are limitations to the use of ultraviolet in the operating room. The germicidal action is a surface effect only and the radiation does not penetrate the surface of liquids but is reflected; hence, droplets are not sterilized. Shadows protect bacteria from the effect of radiation; thus every surface of an object must be exposed to ultraviolet for total sterilization. The action of ultraviolet is not instantaneous and sufficient exposure must be provided for sterilization. The ozone generated by ultraviolet lamps is a hazard and adequate ventilation must be provided to prevent concentrations great enough to cause a detectable odor. Ultraviolet lamps must be tested with a meter at monthly intervals to determine whether the lamps are emitting lethal radiation. Lamps must be cleaned daily to prevent the accumulation of a barrier of dust. Ultraviolet radiation is a hazard in that prolonged exposure will injure skin, tissues, and eyes. The operating room staff must be protected from irradiation conjunctivitis and the skin of the head and neck which is exposed during the operation should be protected. When delicate tissues are exposed in the operative field, the intensity of the ultraviolet radiation should be kept to a minimum.

Above: Members of the A.O.R.N. of New York City served on the planning committee for the program presented for operating room nurses. Left to right, they are: Frances E. Reeser, Carrie Marshall, Rose Wabersich, Joan Driscoll, Anne Dodge Sasse, Barbara Anne Volpe, Helen J. Nolan, and Edith Dee Hall. The nurses also served as ushers during the meetings.

Q. How can banging be eliminated in the sterilizer?

A. The water hammer results from the collapse of steam when it strikes condensate which has pooled in the sterilizer. This can be avoided by providing for the removal of condensate at various points in the steam lines where it is likely to accumulate. This is accomplished by providing a drip pocket to catch the condensate in the steam pipes and a return trap to deliver it into the return pipes to the boiler. Very often the steam trap which drains the jacket of a dressing sterilizer is connected with the steam return line so that condensate is returned to the boiler. If there is a high back pressure in the return line, proper drainage of air or condensate from the jacket is prevented and condensate from the return line is aspirated into the jacket as the sterilizer cools. The lower walls of the chamber are likely to be cold and wet because the cold condensate or air trapped in the jacket prevents heating. Then steam is admitted to the jacket in which condensate pools, condensation occurs and a loud water hammer results. As condensate collects during sterilization, a boiling sound is produced by steam bubbling through the hot water. This can be eliminated by arranging the jacket trap so that it discharges directly into a waste funnel.

Scrub Caps

Members of the New York A.O.R.N. recently inspected various scrub caps to determine which type of cap was best suited to the work of the operating room nurse. Keeping in mind that a scrub cap should fit well, be cool, comfortable, cover the hair, and allow room for ventilation, the cap in circle 11 was selected as first choice and the cap in circle 12 was second choice.

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(1) Miss Wilson, Lincoln Hospital, wears a triangle made of one yard of gauze. (2) Miss Shaw, Lincoln Hospital, wears a helmet of fine white material. (3) A turban made of fine net is worn by Ilse Herrmann, Fordham Hospital. (4) Miss Volpe, Manhattan Eye & Ear Hospital, wears a muslin cap with ties from the back. (5) Miss Williams, Lincoln Hospital, wears a muslin triangle. (6) Miss Dennerlein, Mt. Eden Hospital, wears Bronchoscopic cap for patient, worn to cover the eyes. It is used at Lenox Hill Hospital. (7) Helen Walsh, Veterans Hospital, Bronx, wears a wrap-around triangle of grade A gauze. (8) Mrs. Joan Driscoll, Westchester Square Hospital, uses a triangle of fine batiste with ties attached to the side front and tied back. (9) The cap used at Coney Island Hospital, and modeled by Miss Carvavello, Mt. Eden Hospital, is made of organdie with adjustable band to fit any head size. (10) Mrs. Giddens, Lincoln Hospital, wears the same cap as shown in Fig. 9, but in reverse to cover long hair. (11) Miss E. Szemplenski, Veterans Hospital, Bronx, wears a cap of green muslin (coarse net or organdie), adjustable to any size. (12) Miss R. Wabersich, Lenox Hill Hospital, adjusts Miss Szemplenski's mask.

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How to Dye Operating Room Linens*

● Many hospitals are now using colored linens exclusively in their operating rooms in an effort to cut down glares as much as possible. While sheets and finished garments can be purchased in light blues, greens, and grays now being used in operating rooms, many institutions are dyeing their own linens because they obtain more uniform results at a lower price.

Operating room linens have been dyed in the laundry department of the Orange Memorial Hospital, Orange, N. J., for many years. Knowing this, we asked Miss Cornelia C. Pratt, purchasing agent, to describe the processes used by her laundry manager. She has supplied the following instructions:

——DYEING IN CONVENTIONAL TYPE LAUNDRY MACHINES

Directions for dyeing 100 lbs. of linen (dry weight):

Prepare linen separately, washing and rinsing well in a wash wheel. Do not sour. Extract.

Fill wash wheel to approximately seven inches with water of 160° F.

Prepare in a pail or keg, two gallons of lukewarm water (95° to 105° F.) and 10 lbs. of caustic soda. Add to wash wheel.

(Continued on next page)

Run wash wheel one minute to mix well.

Add dye to the machine and run for one additional minute.

Place wet linen in the machine, open entangled pieces as well as possible. Net all strings loosely. *Do not overload machine—that is important.*

Run machine 15 minutes at 150° F.

Dissolve four lbs. sodium hydrosulphite in two gallons of cold water. Add to machine slowly. Run five minutes.

Dissolve four more lbs. sodium hydrosulphite (as above). Add to machine slowly. Run 15 minutes.

Dissolve four more lbs. of sodium hydrosulphite (as above). Add to machine slowly. Run 10 minutes.

Drop dye bath. Apply two cold rinses. Apply three hot rinses at 180° F. Apply heavy suds at 180° F. Run 15 minutes. Rinse until water runs clear.

SPECIAL NOTES

When working out a formula in your laundry, start with a small lot, not over 50 lbs. Weigh everything accurately and record for future reference. Do not dye over 50 percent of the rated dry weight of your washer.

When dyeing yellow, hold dye bath on a purple color by adding extra sodium hydrosulphite. When dyeing blue gray, hold dye bath on a deep purple by adding extra sodium hydrosulphite.

Be sure to weigh dye accurately and keep a record for future reference.

SOURCES OF MATERIAL

Dye used: Cibanone—Ciba Company, Inc., 627 Greenwich Street, New York 14, N. Y.

Wetting agent (only if water is hard): Triton Oil x 100—Rohm & Haas, 712 West Locust Street, Philadelphia.

This type of dyeing is fast to bleach and strippers; so proceed with caution.

Send to the Ciba Technical Service Division a sample of the color you wish to obtain and they will give you a formula for achieving it. The formula will vary with the hardness of the water. For any problems encountered, contact Ciba Technical Service.

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Ethicon Suture Laboratories, Inc.
New Brunswick, N. J.

In-Service Education in the O.R.

By Edythe Alexander, R.N.

Associate Director of Nursing Service, Roosevelt Hospital, New York City

A paper presented at an Operating Room Institute sponsored by the University of Pennsylvania, Philadelphia

● How can in-service training become a continuous process in any operating room?

In-service training aims to improve patient care and to decrease patient costs by improving the person who gives that care. Today, in-service training is essential because proper patient care demands the application of innumerable technological and scientific procedures which have created more responsibilities. Consequently, we have less nursing personnel to assume them. Therefore, human resources are our most expensive commodity.

Today, the in-service training director must decide what kinds of nursing are needed, who is qualified to do the various duties, and how different nursing groups should be trained. The Army, Navy, Institutes of Operating Room Nurses, The National Committee for the Improvement of Nursing Services, and many hospitals have developed in-service training programs for the graduate nurse and the technical attendant.

When considering in-service training we might remember C. R. Dooley's remarks. He states, "Training is not something that is done once to a new employee, it is used continuously in every well-run establishment. Every time you get someone to do a task the way you want it done, you are training. Every time you give directions or discuss a procedure or a problem, you are training.

DAILY TRAINING

Training occurs when people are cooperating, participating and developing within their daily nursing experiences. For each of us, understanding starts from the central point of personal experience. It is important that we examine our own feelings and attitudes toward in-service training. A training program should create a working environment in which all nursing staff personnel and hospital groups can understand each other better.

We must be ready to accept change. We welcome the new mechanical devices, such as plastic materials, high speed sterilizers, packaged "sterile" suture materials and sterile linen packs; but not changes which affect our feelings and personal attitudes.

Changes in job functions and duties, acceptance of

different nursing groups, and acceptance of on-the-job training are changes that require flexible thinking and objective planning.

Another important factor in human nature is the strongly felt need to be a recognized and effective part of any group. No one feels successful until she or he has felt the experience of teamwork and shared that experience with another person. This may happen when two nurses prepare for an operation in a few minutes, when a surgeon says, "Well, done!" when a supervisor asks a staff nurse how a procedure could be improved, or when the administration asks a supervisor for suggestions.

THREE PRINCIPLES INVOLVED

Effective in-service training must be based upon the following three principles.

1. Team Spirit: The desire of the administration, the medical staff, and the nursing staff to work together for the welfare of the patient. Team spirit is essential to all training programs. A democratic structure is based on the actions of a small group, while an authoritarian structure is based on obeying. Perhaps, the traditional patterns of our operating rooms hamper the desire for team spirit.

2. Teamwork: The smoothly coordinated activity that characterizes a closely knit group. A team works as a unit. This kind of participation and cooperation involves face-to-face relationships and continuous practice in supplementing each other as team members. When team members have one common goal each is able to make a practical suggestion for better patient care. The teacher or leader is a member of the group and the patient care problem is the central point.

The effective team member knows her job and understands the other person's job. In such an environment the person giving patient care improves his or her thinking and skills.

A crisis forces an effective team to meet the new need by their group participation, their understanding, the feeling of status and prestige.

When a threat accosts a loosely integrated group the reaction may be just the reverse. The supposed team may break apart, each member taking care of her or his own personal desires and immediate needs. In such disintegration we may hear many remarks and grievances.

3. Cooperative relations is a third principle underlying a successful training program. Such relations involve representative groups of the hospital staff who work together within a well-established functional and live organizational structure. It is then that programs are established and operated to suit each staff member's needs.

DIFFERENT IDEAS AND ATTITUDES

We seem to have different ideas and attitudes toward in-service training. Perhaps, we have too many conservative liberals or liberal conservatives in our midst? Dr. Cornford says, "The men of both parties are alike in being open to convictions; but so many convictions have already got inside, that it is very difficult to find the openings. They dwell in the Valley of Indecision." Dr. Cornford also describes another group which we may be able to recognize. They are Non-Placets. "They differ from

the others in not being open to conviction; he is a man of principle. A principle is a rule of inaction, which states a valid general reason for not doing in any particular care what to unprincipled instinct would appear to be right." In a program which includes recruitment, selection, orientation induction, instruction, follow-up, evaluation, the top hospital and nursing administrative groups must help to build a well-established program within the live organization. Ideas and attitudes of the staff must be in agreement concerning the program.

Once a training program for graduate nurses, technical attendants, or nursing aides has been determined, the director of in-service training and supervisor in consultation with the nursing personnel involved should consider the following points: (1) who is to be trained, (2) who is to do the training, (3) the content of the training program, (4) when, how long, and where should it be done.

TRAINING TECHNIC IMPORTANT

The knowledge of training technic is important for the success of a program. Teaching is a skill and an art that can be learned. The following steps could be used by a person who is doing the training. They are:

1. Have a timetable.
2. Break down the tasks in the order of sequence—stress the key points of each step.
3. Have everything ready for a demonstration.
4. Use the actual situation when possible.
5. Prepare the person—put her or him at ease, create interest and the desire to learn.
6. Present the task—tell, show, illustrate the question.
7. Try out the performance—repeat demonstration, stopping only when a serious error occurs.
8. Practice in a real situation.
9. Follow-up—inform person of new methods—get his or her ideas.
10. Evaluation—periodic intervals, standard form and method.

Benefits from in-service training cannot be realized unless all personnel are convinced that systematic training will benefit them. If the program is to get good results, the staff must want to learn, and the supervisor must want to teach.

Recruitment, selection, and induction require that jobs be defined and duties listed in the daily work-performance. This is essential when personnel are selected to meet the job requirements and qualifications.

Good training requires standardization of procedures. Work-performances and operational methods can be studied by the professional and non-professional members. This also becomes a training experience. Charles F. Kettering defines research as: "a process of finding out what you are going to do when you can't keep on doing what you are doing now, or what are you going to do when you quit doing what you are doing."

A training program enables the present staff to acquire more and greater skills; thus increasing their versatility and their qualifications for new positions.

For example, a group of nurses increased their own knowledge, improved standards, decreased costs, and im-

proved the working conditions in patient care. These results developed from studying the wasteful use of suture materials.

THE PROBLEM AND ITS SOLUTION

Briefly the problem and its solution developed in the following manner.

1. Supervisory group and administrative hospital group believed that suture material costs could be decreased.

2. Problem presented to nursing personnel by supervisor. Could we improve our methods of handling suture materials? Many questions were discussed. They included: How can we stop throwing away yards of cut sutures and still have the sutures ready for the surgeon? How can we get Dr. —— to stop using one strand of catgut for one suture? How much does a tube of catgut cost? Is an atraumatic suture more expensive? What kinds of suture materials are most frequently used for various types of operations?

3. Nurses studied the daily situation in relation to kinds of sutures used—amount—type—size. Supervisor discussed project with surgical staff—data was kept, then tabulated.

4. Methods were studied for handling suture materials, including storage, sterilization, preparing ligatures and sutures at the operative field. This involved time and motion studies in a simple manner.

5. Basic skills and methods were agreed upon by the staff. All members received in-service training according to new skills.

6. Standardization of suture materials for various operations was presented to surgical staff. Listings on cards were evaluated, studied, and revised.

7. Card Index file system was put into effect.

8. Over-stocked weekly supply of suture materials and those not used were returned to stores.

9. Yearly standard for suture material was established.

This training experience created prestige and status in the group as well as improving standards.

Training is a mutual, related, and continuous process. It is a process by which technical knowledge and human needs of the nursing staff member can be satisfied and patient care is improved.

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Training Technicians for the O. R.

Experiment at Norfolk General Hospital Shows Technicians Can be Trained to Help Relieve Nursing Shortage

By R. A. Cramer, Administrative Assistant
Norfolk (Va.) General Hospital

● At Norfolk General Hospital, we have undertaken to train young women to become operating room technicians. We feel that scrubbing and circulating in the operating room can be done safely and efficiently by a lay person qualified by virtue of age, mentality, and an adequate amount of specialized training.

Our first step was to obtain the backing of the surgical staff. We outlined the proposed training program to the chairman of the Surgical Authorities Committee of the staff. The program was then presented to the general staff and was accepted. The staff was asked to volunteer help in recruiting students to start the course. What we had anticipated to be our toughest hurdle actually turned out to be the easiest.

In recruiting students we set up the following qualifications:

1. High school graduation
2. Age—19-35
3. Interest in specialized training for a livelihood and career.

Each applicant is thoroughly interviewed to determine her interest. We have found that the student's interest is absolutely essential in order for them to satisfactorily complete the course. We have learned that this is of utmost importance. Our first class began with six and now one student is left.

OUTLINE OF TRAINING PROGRAM

I. Didactic Instruction

1. Surgical Anatomy: taught by resident in surgery (10 hours)
2. Operating Room Technic: taught by O.R. clinical instructor (60 hours)
3. Medical Terminology: taught in conjunction with the courses in anatomy and operating technic
4. Medical Ethics: taught by O.R. clinical instructor (5 hours)
5. Hospital Organization and Management: taught by administrative assistant (4 hours)

II. Practical Training

1. Linen preparation
   a. Nomenclature
   b. Assorting
   c. Folding
   d. Assembling packs
2. Glove preparation
   a. Cleaning
   b. Testing
   c. Powdering
   d. Packing
3. Sterilizing Room
   a. Operating autoclave and water sterilizers
   b. Preparation of solutions
   c. Ordering drug room supplies
   d. Emergency sterilizing
4. Suture Room
   a. Nomenclature
   b. Preparation and care of suture material
5. Instrument Room
   a. Nomenclature
   b. Care and cleaning
   c. Packing sets
6. Operating Rooms
   a. Observing periodically for six weeks
   b. Circulating
      1. Under supervision of major and minor cases (2½ months)
      2. Solo
   c. Scrubbing
      1. Under supervision on major and minor cases (2½ hours)
      2. Solo

From the outline it can be seen that the major portion of training is on a practical basis. The three and a half to four months the girls spend working with linens, gloves, sutures, instruments, and autoclaving thoroughly familiarizes them with every piece of equipment and all supplies actually used during an operation. When they have completed the training and go into the operating rooms they are individually supervised until it is felt that their knowledge and ability have progressed to the point that they can work without constant supervision.

Students are paid on a graduated scale of three month intervals; $75 per month for the first three months; $125 per month for the second three months, and $150 per month for the last three months. We feel this is justified on the basis of the service the student renders and the work they perform as their experience progresses.

Our first class of six students started in March of this year; we now have one student left. She is progressing rapidly and is doing an outstanding job.

Last September, after a great deal of deliberation and individual investigation, we admitted nine girls. We have taken two students in this class who did not finish high school as an experiment to compare their ability to learn and to do the work with the other students who have a high school education. We feel that these two girls have so much interest in the course that it will outweigh their lack of formal education.

RELIEVE SHORTAGE OF NURSES

We firmly believe that operating room technicians will amply provide an adjunct to the now existing critical shortage of graduate nurses in operating rooms. We just as firmly point out that they are in no manner intended to replace the graduate nurse, or are we under any impression that technicians will completely eliminate the graduate nurse from the operating room: they are neither trained nor qualified to supervise which, of course, is one of the jobs of the graduate nurse.

It is important that both the graduate nurse and the technician understand the place of the technician on the operating room team. The technician in our hospital has been openly accepted by our graduates.

Question Box

Each month questions pertaining to O.R. problems and technics will be answered by Dr. Carl W. Walter, nationally known for his operating room technic courses and as the author of "Aseptic Treatment of Wounds" (MacMillan). Questions should be addressed care of the O.R. Editor, Hospital Topics.

Q. The radium for insertion into the cervix comes to us in a heavy lead container. We have asked the radiologist if we may leave the lid off for sterilization, and he says it is not necessary. Do you agree?

A. There is a tradition to being careless about the disinfection of radium applicators. The chief difficulty encountered as a result of this carelessness is occasional tetanus or gas bacillus infection in the uterus, due to faulty disinfection. Accordingly, I feel that radium should be properly sterilized before it is inserted into the uterus. The lid should be open far enough to permit the exchange of air and steam or should be removed so that the radium can be moistened before it is put into the sterilizer. Either technic is satisfactory.

Q. Do you consider of any importance, instrument tables with a back screen over which a sterile sheet is draped?

A. I do not believe the back screen contributes anything to the safety of the patient in the operating room. It is expensive and cumbersome and controls settling out of

bacteria on a relatively small portion of the sterile field. It is more important to be certain that the floor is kept clean and free of dust, so that air-borne contamination is minimal.

Q. Is it possible to sterilize VASELINE and oils in a steam pressure sterilizer when a dry heat sterilizer is not available?

A. An easy way to sterilize VASELINES and oils is to put them in a steam sterilizer and expose them to saturated steam at 250° for 30 minutes. At the end of this period, the steam to the chamber can be turned off and the steam in the jacket left on for a four-hour period. In this way thorough heating is accomplished during the steam cycle, and the grease and oil are moistened enough so that the exposure to dry heat is effected.

Q. What is the proper technic for cleaning up after a case of gas bacillus infection?

A. Controlling spread from a patient with this infection consists largely of controlling the discharges from the wound. This means sterilization of instruments which come in contact with the wound and incineration of the dressing material. The bedding and mattresses present no more problem than they do after the usual patient. The problem of air-borne contamination is ever present because the organisms are present in street dirt and are tracked into the operating room on shoes. A patient with clinical infection with the organism does not make the problem any more serious.

The dirty case technic described in Chapter 15, *Aseptic Treatment of Wounds*, is adequate for cleaning up after such an infection.

Q. At present we are considering everything left in the room during a "dirty" case contaminated, including supplies on the anesthetic stand and in cupboards if doors have not been tightly closed. Is this necessary in a simple "pus" case, or may we consider it a dirty field and use terminal cleaning only on equipment in direct contact with the infected material? Are there some cases, such as tuberculosis, in which everything in the room is considered "dirty"? Is the method of cleaning described in the 1948 edition of Aseptic Treatment of Wounds *still the accepted method?*

A. A case should be considered dirty whenever potentially dangerous organisms are encountered. Any of the virulent pathogens must be disposed of to prevent infection of the personnel or other patients; hence, routine calls for special care of the instruments and dry goods following cases in which pus or gangrene is encountered, compound injuries, or operations upon the intestinal tract or perineum.

Care must be taken to see that spots of blood and pus on the floor are immediately disinfected. Lime paste should be spread on the spots as soon as they occur during the course of an operation. The lime paste is subsequently mopped up with the usual germicidal solution used in the mop pail. Any spots on the walls must be treated in the same manner. I do not feel that the walls or cabinets merit anything more than usual housekeeping unless there is evidence of gross contamination.

The technic described in Chapter 15, *Aseptic Treatment of Wounds*, is adequate for cleaning up after a contaminated case. It must be remembered, however, that the quaternary ammonium compounds do not kill the tubercle bacillus, even on prolonged exposure, and in cases in which the bacillus is a contaminant, a solution of calcium hypochlorite should be used for cleaning furniture, floors, bronchoscopes, etc.

Q. We do numerous cystoscopic studies, and collect specimens for cultures, but recently most of our pathological reports have read "Sterile Specimen." I have been immersing the ureteral catheters in a solution that is known as Cystan, allowing them to soak the allotted period of time and then flushing them with sterile water. Could you recommend a different routine or point out my mistake in preparing the catheters? Do you approve of a Formalyn box?

A. Urological equipment should be cleaned with a good detergent such as Tide, dried, and disinfected by soaking in an aqueous solution of any of the quaternary ammonium compounds for three hours before use. Rinse the instruments and catheters thoroughly with sterile water before using to prevent inhibition of cultures' growth.

Heat-resistant cystoscopes and nylon catheters which will withstand steam sterilization are commercially available.

There is no satisfactory formalin cabinet available, inasmuch as dry formalin gas does not sterilize.

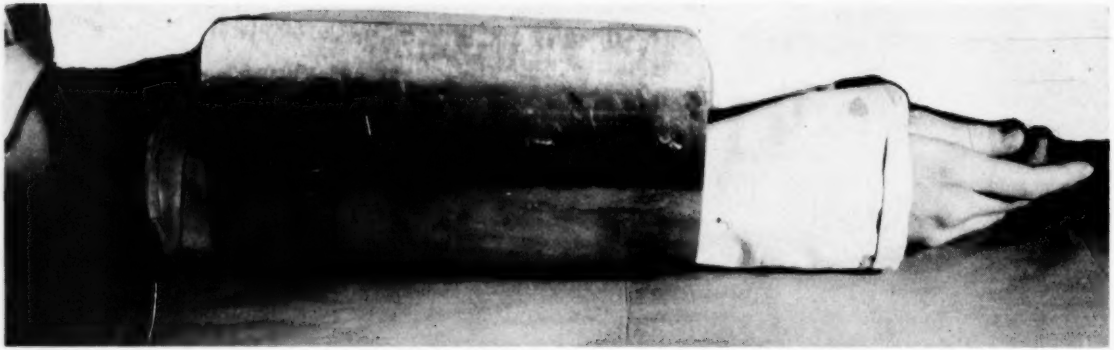
Q. May I have suggestions regarding the organization and function of a Surgical Committee in a hospital.

A. The size and function of a Surgical Committee in a hospital depends on the bed capacity of that hospital and the philosophy of its surgical staff. I feel strongly that it should include one of the youngest members of the surgical service, a man with enough free time and enthusiasm to make the committee a worthwhile function. A committee should include an operating room supervisor, surgical supervisor, and a representative of the administration and nursing service. Procedures relative to the care of the surgical patient or organization of equipment for that care should be routed through this committee and the technic coordinated so that there is uniformity of equipment, preparation, use and after-care. This will result in appreciable saving of both personnel time and money.

Q. I am working in a small hospital which has a steam autoclave for sterilizing instruments but does not have a dry air sterilizer for sharps, VASELINE gauze, etc. Would it be satisfactory to use an ordinary electric cooking oven for this purpose? If not, would you tell me what type of hot air sterilizer would be satisfactory and of a reasonable cost.

A. Every steam sterilizer can be used as a dry-heat sterilizer. This is done by turning steam into the jacket but not the chamber and allowing for a prolonged period of exposure. In dry heat at 250°F. it takes six hours to kill dry, resistant spores. A good technic is to load the steam sterilizer at night with cutting edge instruments, etc., lock the door, turn the steam into the jacket but not the chamber, and leave the sterilizer on all night. In the morning the instruments, etc., are sterile.

The Surgical Armboard



● The use of the antecubital space for the administration of drugs, fluids, or blood during a surgical procedure presents problems of positioning and draping to prevent interference with the operative procedure.

The Surgical Armboard attachment is intended to eliminate the hazard of contamination and the inconvenience of draping and positioning. The arm opposite the side on which the surgeon expects to stand is prepared in the usual manner and the intravenous started. The arm is arranged in the optimum position, the sleeve is attached and adjusted and draped simultaneously with the rest of the operative field.

The usual flurry incidental to avoiding contamination from the exposed arm and apparatus is eliminated. The annoying slipping of the haphazard arm drape is also eliminated. A sterile surface presents to the field and team at all times and the sterile drape maintains its efficiency in any position made necessary by a procedure change.

To avoid traction on the brachial plexus from an abducted arm, many surgeons prefer to keep the patient's arm adducted. A "J" shaped metal shield placed under the mattress and around the patient's arm prevents pressure by members of the surgical team on the supinated arm and dislodgement of the intravenous needle which is positioned before the patient is anaesthetized.

The O.R. Problem Clinic

by EDITH DEE HALL R.N.

● A page set aside for the discussion of administrative problems in the O.R.

Q. Recently we equipped a 10 bed recovery room. As the operating room supervisor, I was given the responsibility for supervision of this new unit. In addition to the fact that my operating room duties are already heavy, I feel that a person experienced in post-operative care should have this responsibility. I would like to have your opinion on this matter.

A. A recovery room is a unit which requires expert supervision and calls for a full time supervisor who is capable of meeting any emergency which might arise following surgery, especially the advanced surgery of today. Its supervision should not be divided with a unit of equal importance and equal responsibility. I feel strongly that supervisors in busy operating rooms should not have to supervise care of patients in the recovery room.

Q. The storekeeper or purchasing agent in our hospital selects and orders all supplies. As supervisor I am never consulted as to type, quality, or quantity of articles purchased for the operating room. I think I could help reduce expenses and even effect an economy in my department if I were permitted to offer suggestions. What is the general policy in regard to this?

A. Hospitals which have good inter-departmental relationships permit department heads to take an active part in planning and assisting with the selection and buying of equipment. Articles used in the operating room are varied and expensive and have many factors such as durability, care, and suitability to be considered. The advice and suggestions of one skilled in their use should not be overlooked. Since you are not permitted to give advice to the purchasing agent, I recommend that you keep a record of all supplies received as to quality, quantity,

time put in use, cost, time replaced, etc. At the end of six months or a year you will have facts which can be presented to your superiors along with your request that a change be made in the purchasing procedure.

Q. Do you consider a hospital policy book an important administrative tool?

A. A well written, up-to-date policy manual containing all operating room rules, regulations, and policies is invaluable. It is extremely helpful in an orientation program. All permanent personnel should be held responsible for reading the manual. When new information is added it is wise to call this to the attention of the staff by posting a notice on the bulletin board. By proper use of a good policy manual, no excuse can be offered for "not knowing."

* * *

Q. Two of my eight staff nurses feel they should be responsible for one room each and scrub for the same surgeons all the time. The other nurses rotate willingly, but feel that some plan should be followed. What is your opinion? We do not have students.

A. To eliminate confusion and have a smoothly run service, it seems advisable to have all nurses rotate until they are familiar with all the services. This is necessary to prevent havoc when nurses become ill or take vacations. The work load is more evenly distributed and a better feeling among the nurses will result. Once the nurses have rotated, a system can be worked out to make each one, by mutual agreement, be responsible for a definite service. This would not apply, of course, to scrub nurses who are hired by individual surgeons.

Q. Should staff education be planned by a Staff Education Committee?

A. I presume you mean a committee on education with operating room staff nurses participating. Any plan in the educational program developed to stimulate nurses to help themselves is excellent. To be on a Staff Education Committee is a challenge for the nurse to attempt to improve conditions and better the general service in the operating room. It would be a good idea to rotate staff nurses on such a committee so that they all have an opportunity to serve.

Q. What type of records (involving patients) should be kept concerning accidents that happen in the operating room?

A. There are several important points to consider on such reports. A fair and accurate report should be written with enough detail to make the situation understandable even years later. The report should be so written that only one interpretation can be made from it. All statements should be signed by the nurse who wrote them and should be approved by the director of nursing services. All reports should be written in ink with no erasures. Ink eradicator should not be used; corrections give the impression that the report has been changed and may prove embarrassing in court. It is advisable to file a copy of all reports in the hospital administrator's office.

Q. Do you advise the use of a manual in orientation of nurses? What should it include?

A. An orientation manual is very useful. It can be combined with the Policy and Rule manual and should include

such additional information as:

a. Names and positions of all key personnel in the hospital.
b. Name of immediate supervisor and her assistant.
c. Drawing of the floor plan.
d. Hours and place for meals.
e. Time allowed for sick leave.
f. Time allowed for vacations and holidays.
g. How to locate equipment.

Every hospital can add to this list according to the need.

If a Policy and Rule manual is not used, the Orientation manual would necessarily have to be more complete. Detailed information as to where all supplies are found can be kept in a card file.

Q. Do you consider a small operating room library of enough benefit to warrant the expense of equipping one? Our list will be limited at first to books on surgery, anatomy, and operating room technic.

A. If space allows for a room where nurses may make use of books on operating room subjects, it is by all means worthwhile. Often nurses puzzled over a preoperative diagnosis, a question on anatomy, or a procedure planned, would welcome a chance to read about it before scrubbing. Time does not often permit the nurse to leave the department and go to the hospital library. The right books in the right place can be stimulating as well as helpful.

Q. Should schedules be planned to continue through the lunch hour? What do you consider a fair time for the last cases to be booked in the afternoon? Our regular staff only covers from 7 a.m. to 7 p.m.

A. This problem must be worked out in individual hospitals according to the amount of surgery done and the number of persons on the operating room staff. As a rule nurses feel that an early start is important. A planned break at lunch is appreciated. You will find that if nurses have an opportunity to go to lunch at a reasonable time, relax, eat, and return to make a fresh start, there is less confusion and dissatisfaction. Naturally we must all make allowances for emergencies and for an occasional case to run overtime. The last cases should be booked not later than 3:30 p.m. This allows for earlier cases that have not finished and takes care, in part, for any rush at the end of the day. Operating rooms which have nurses to relieve at 3 or 4 p.m., must plan differently.

Q. Should nurses be paid for staying in "on call?" If they are called out should they be paid extra?

A. Yes, nurses should be paid for staying in and should receive an extra fee for each operation for which they are called. Nurses on other services are not expected to do day and night duty and the hospital must provide service whether it be for an emergency or not. The fees paid to "on call" nurses seldom amount to more than one salary per month. This is at the rate of three dollars for staying in and five dollars for each operation.

Q. We recently have reviewed the objectives of our operating room. The general feeling is that a great deal has been accomplished, especially in improving technic, having proper supplies on hand, etc. The objective of developing better interpersonal relationships seems to be at a standstill. Can you suggest a means of stimulating action?

A. Perhaps the objective is too broad and needs to be broken down to give a clear understanding to all who will participate in its accomplishment. You might set aside a specific goal for one week, or any length of time you choose, such as that of developing better relationship between nurses and auxiliary workers. Try to improve upon attitudes, manners, and ways in which orders are given, received, and executed. There are dozens of little improvements to be made, and as a more pleasant atmosphere develops nurses and auxiliary workers will see the change in interpersonal relationships.

Q. In our operating room we have had some discussion as to the scheduled time for operations. Does the hour the operation is booked mean the time for the surgeon to arrive or the time the incision is to be made?

A. The scheduled time means incisional time with all members of the team present and ready to function. Naturally the anesthesiologist arrives earlier and has the patient ready for surgery at the appointed time.

Q. Our hospital is undergoing changes to introduce safety devices and controls, especially in the operating rooms. At present there is a great deal of discussion and difference of opinion, with very little being accomplished. Do you think it would be helpful to have a safety committee?

A. Yes, especially until the project has been completed. The operating room supervisor does not need to be a member of this committee, but may be called in consultation. There need be no difference of opinion on what should be done as long as the changes conform to standards set up by the National Fire Protection Association regarding explosion hazards. The safety committee may set up policies and rules to be followed after the project is completed. It may also function for safety throughout the hospital, by appointing responsible personnel to make routine rounds and check all floors for unsafe equipment such as old ladders, frayed electric cords, poorly lighted stairways, etc.

Q. I am an operating room supervisor in a hospital in which O.R. schedules are crowded and heavy most of the year. The problem of housekeeping in this department causes me no little concern. In my opinion, cleanliness is absolutely essential in maintaining good technic. When time permits our rooms are properly cleaned, but the cleaning is not adequate from day to day. Have you any suggestions?

A. A method which was recently discussed in an operating room institute, seemed desirable and effective. The housekeeping department of the hospital and the operating room supervisor combined their efforts and worked out a plan for cleaning. Since the housekeeping personnel were trained in all types of cleaning, it was decided that they were best fitted and equipped to clean the operating rooms. The time set was for a late hour in the afternoon when most of the surgery had been completed. At approximately the same hour each day, a cleaning force with its own supplies and equipment, came to the operating rooms to clean floors, walls, woodwork, furniture, or whatever was necessary. Thus the department underwent a thorough cleaning every day. A full-time porter was on duty in the O.R. to take care of the floors between cases. Nurses found this system very satisfactory.

Q. I am an operating room supervisor and am writing to you in hopes that you can help in solving one of our problems. Of late we have had several errors in the confusion of ether and alcohol for procaine. Both of these, of course, are colorless fluids. Is there any possibility of coloring procaine?

A. Several anesthesiologists and pharmacists in our leading hospitals have been consulted for the answer to this question. All agree that procaine and other injectible solutions should not be colored. They suggest a one per-cent solution of Amaranth for coloring the alcohol.

Your letter does not state in what type container you have these solutions and whether or not they are part of your sterile set-up. Naturally the first step is having the bottles or flasks clearly and properly labeled; then I should like to suggest the use of sterile glass markers to be used after the solutions are poured into containers on the sterile table. These markers are similar to a catgut tube with a typewritten label sealed inside. You may make a list to fill your needs and purchase them through your surgical dealer. These markers may be sterilized with your instruments and serve as a valuable safeguard when placed in solutions.

Q. I would like your suggestions as to how I can keep my policy and procedure books up-to-date and be sure that all the nurses have read them. Too often their excuse is, "No one told me."

A. One method is to have each change or new rule typed on a memorandum and initialed by each member of the staff before it is entered in the book. This means that initialed memos will have to be kept for some time. You can also detail a given time for each person to read and sign the manuals.

Q. We recently received quite a large quantity of surgical instruments including forceps, retractors, scissors, etc. Although the instruments are made of stainless steel and are given very good care, we occasionally find small specks of rust or corrosion. Can you explain this?

A. When red rust or stains appear it is due to a combination of moisture with the steel, especially with the carbon in the steel. In order to obtain good resistance to corrosion, steel must have high chrome content and be carefully heat treated in both the hardening and drawing processes. Instruments made with disregard for the highest standards cannot maintain complete rustless qualities.

Q. In your opinion is the lack of operating room knowledge exhibited by graduate nurses, due to their inability, as students, to absorb the multiplicity of procedures and technics, or the result of haphazard teaching?

A. I presume that you refer to recent graduates. There is no answer which can be applied to all cases. Often poor teaching is due to lack of time and shortage of instructors so that even promising students fail to receive proper instruction in the operating room. If a student fails to absorb the instruction given, she is made aware of this and usually feels too insecure to continue in this field without more preparation. In many schools, students are not used for service in the operating room and should have the advantages of more preparation or a good in-service program if they wish to continue in this field after graduation.

Q. Objections have been raised because my nurses wear their scrub caps into the dining room. I have permitted this because the time spent in changing caps and arranging hair is of considerable importance, particularly at noon time when we are rushed trying to get ready for the afternoon operations. What is your opinion?

A. Unless the one making the criticism has been consistent in checking all attire that goes into the dining room, starting from the shoes up, there is no reason to single out the operating room scrub cap. Since there is no question of asepsis, it should be permitted as a measure in economy of time. Masks should be discarded before leaving the operating room. Scrub caps should be neat and presentable, and should not be worn to and from duty.

Q. Our hospital is small but largely surgical. Our surgeons use silk sutures to a great extent and this creates quite a problem in preparation. We do not have enough auxiliary help to cut, wind, and wrap silk so that we always have a supply ready. What do you suggest?

A. Practically every suture company today is aware of this problem and has worked out some convenient means of handling silk. You can purchase silk in all sizes, cut in desired lengths and packaged in small paper envelopes ready for sterilizing. Silk wound on small rubber reels, with the size indicated on the rubber can also be purchased. This silk is wound so that it does not tangle in handling. One of the newest products is silk cut in strands of a desired length and sterilized, dry, in glass tubes. These tubes can be purchased in containers with storage fluid just as we buy catgut. With so many helpful products carefully planned to save time and labor, many of our problems are solved.

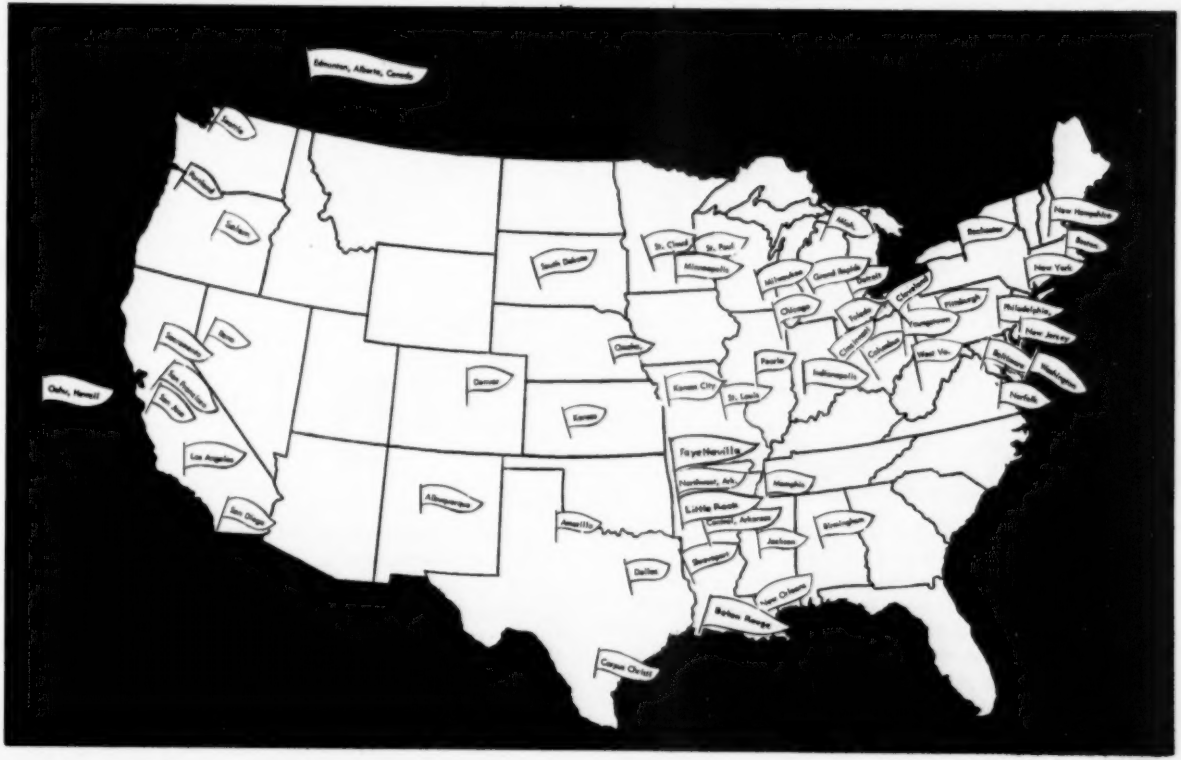
* * *

Q. To what do you attribute a staff nurse being unwilling to improve or make changes in the operating room?

A. Lack of interest and sometimes ambition which may be caused by one or a number of things. An effort should be made to find the cause and help her in making adjustments, if possible. The nurse may be unhappy in her position, worried and overtaxed with outside responsibilities, ill, or unfriendly. She may be very grateful for help and guidance.

Q. Our operating room unit consists of four rooms, and we have a fairly busy service. Usually we have no difficulty in settling problems, as our surgeons are cooperative and our anesthesia department functions very well. Is there any advantage in having a surgical committee over a system that seems adequate?

A. If you have a smooth-running service with a satisfied and cooperative group, there certainly is no point in changing, particularly if other departments are also satisfied. Surgical committees are especially helpful where there are problems involving other departments, or where there is friction and discord in the department itself. One marked advantage is the sharing of responsibility in solving problems. All angles of the problem can be brought out by the committee, and each has an opportunity to express his opinion and work on the solution. A properly functioning surgical committee shares and lightens the burdens of the operating room supervisor.


Edmonton, Alberta, Canada
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Salem
Oakland
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San Diego
Oahu, Hawaii
Albuquerque
Amarillo
Dallas
Beaumont
Corpus Christi
Denver
Kansas
South Dakota
Omaha
Kansas City
St. Louis
Fayetteville
Northwest, Ark.
Little Rock
Central Arkansas
Memphis
Jackson
Birmingham
New Orleans
Baton Rouge
St. Cloud
St. Paul
Minneapolis
Milwaukee
Grand Rapids
Detroit
Chicago
Toledo
Cincinnati
Columbus
Peoria
Indianapolis
West Va.
Cleveland
Pittsburgh
Rochester
Buffalo
New York
Philadelphia
New Jersey
Baltimore
Washington
Norfolk
New Hampshire

PORTLAND

● A group of 12 operating room supervisors, representing 12 leading hospitals in Portland, Ore., and Vancouver, Wash., gathered recently in Portland to plan the organization of an Association of Operating Room Nurses of Portland and surrounding area.

Elected president of the group was Gladys House, Portland Sanitarium and Hospital, Portland. Eleanor Mallory, Doernbecker Children's Hospital, Portland, is vice president; Alice Davies, University State Tuberculosis Hospital, Portland, is secretary, and Helen DuBois, Vancouver Memorial Hospital, Vancouver, is treasurer.

Pictured in the group above are, front row, left to right: Catherine MacNaughton, VA Hospital, Portland; June Melgreen, Matson Memorial Hospital, Milwaukie, Ore.; Alice Scharf, Multnomah County Hospital, Portland; Alice Davies, and Eleanor Mallory.

Back row, left to right, are: Eleanor Peterson, Shriners' Children's Hospital, Portland; Vivian Rains, VA Hospital, Vancouver, Wash.; Kathleen Anderson, St. Vincent's Hospital, Portland; Gladys House; Helen DuBois; Alice Midthun, Emanuel Hospital, Portland, and Marjorie Watters, Northern Permanente Hospital, Vancouver.

Nurses in OAHU, Hawaii, Form A.O.R.N

Above: New officers are, seated l. to r.: Sister Roseanne, Mrs. Margaret Rodearmel, and Dorothy Burtch. Standing: Mary Lee and Vivian Pereira.

● One of the newest associations of operating room nurses is that of Oahu, Hawaii. Interest in organization began back in February when 28 nurses from 16 hospitals in the city and rural areas of Oahu met to consider formation of an A.O.R.N. Interest was so tremendous that plans were immediately started for an official group.

Several organizational conferences were held. Finally on April 16 a meeting was

held, constitution and by-laws were adopted and officers were elected. It was agreed that members should be registered professional nurses engaged in active operating room work.

A meeting followed on May 4 at St. Francis Hospital. A gavel, inscribed with the name of the first president of the group, and the birth date, May 4, 1953, was presented to the president to be handed down to future presidents. After the meeting, colored slides taken at the Leprosarium at Kalapapa were shown by Sister M. Roseanne. Refreshments which followed included a birthday cake for the organization.

At the second meeting on June 2, the group decided to wear typical island dress for a group photograph.

The first officers of the organization include: President, Mrs. Margaret Rodearmel, R.N., Leahi Hospital; vice-president, Mary Lee, R.N., St. Francis Hospital; secretary-treasurer, Vivian Pereira, R.N., Territorial Hospital; program committee, Sister Roseanne, R.N., St. Francis Hospital, Dorothy Burtch, R.N., Queens Hospital, and Lillian Nantkes, R.N., Kuakini Hospital. Hazel Neff, R.N., Children's Hospital, is chairman, nominating committee.

Group photograph includes, back row, left to right: Francis Souza, St. Francis Hospital; B. Brewer, Wailua Hospital; Violet Mossman and Myra Ching, St. Francis Hospital; Marge Coscarelli, Wahiawa Hospital; Barbara McPhee, Queens Hospital; Margaret Ormand, Tripler General Hospital; Opal Catlin, Waimea Hospital, Kauai; Mary Lee, St. Francis Hospital; Colene Harris, Territorial Hospital, Kaneohe; Maura Donahue, Queens Hospital; Vivian Pereira, Territorial Hospital, Kaneohe, and Dorothy Burtch, Queens Hospital. Second row: Grace Shintoni, St. Francis Hospital; Phyllis Briggs and Betty Jo Schumann, Queens Hospital; Alyce Parsons and Margaret Rodearmel, Leahi Hospital. Front row: L. Hyun, St. Francis Hospital; Helen Sheriff, Wahiawa Hospital; Kathleen Murphy, Leahi Hospital; Mabel Oshiro and Ellen Jane Murakami, Queens Hospital.

Panhandle A.O.R.N. Organizes in Texas

● Operating room nurses, supervisors, and personnel representing eight hospitals in the Panhandle area of Texas convened recently to plan a local unit, the Panhandle Association of Operating Room Nurses.

Sister Mary Carol, St. Joseph Hospital, Wellington, presided at the business meeting. A constitution and by-laws were adopted and the officers of the organization were elected.

Sister Mary Theabalda, St. Anthony Hospital, Amarillo, is president. Thestle Donaldson, Northwest Texas Hospital, Amarillo, is vice-president; Loretta M. Achen, VA Hospital, Amarillo, secretary; Kathleen Lee, Sanford Hospital and Clinic, Perryton, treasurer, and Lucile Dohmer, Northwest Texas Hospital, Amarillo, program chairman.

Object of the association is the promotion of friendly assistance and good fellowship among its members.

Central Arkansas *forms* A.O.R.N.

● The first meeting of the Central Association of Operating Room Nurses was held recently in Little Rock. Thirty-four nurses representing 10 hospitals got together at a dinner meeting to plan the organizational stages of their group and to formulate ideas for coming meetings.

Edward Fitzgerald, ORS, VA Hospital, Little Rock, was elected president. Doris Lovett, St. Vincent's Infirmary, Little Rock, is the vice-president, and Mildred Smith, ORS, Children's Hospital, Little Rock, is the secretary-treasurer.

Attending the meeting and shown in the group photograph above are: Anita Hill, Vivian Herron, and Romona Gately, Arkansas Baptist Hospital, Little Rock; Bonnie Jo Boyd and Marjorie Kendrick, Children's Hospital, Little Rock; Francis Fessler, Hot Springs County Hospital, Malvern; Lorena Pim, Joan Tucker, Margaret Nordman, and Anna Mae Brantley, University Hospital, Little Rock; Maxine Otey, Betty Mahurin, Helen Kelley, and Eulene Mathis, Missouri-Pacific Hospital; Ivy Miller, Marie Allboitton, Mary Hambuchen, Dorothy Akin, Marie Collins,

(*Continued on next page*)

Above: Edward Fitzgerald, president of the new group, confers with the vice-president, Mildred Smith.

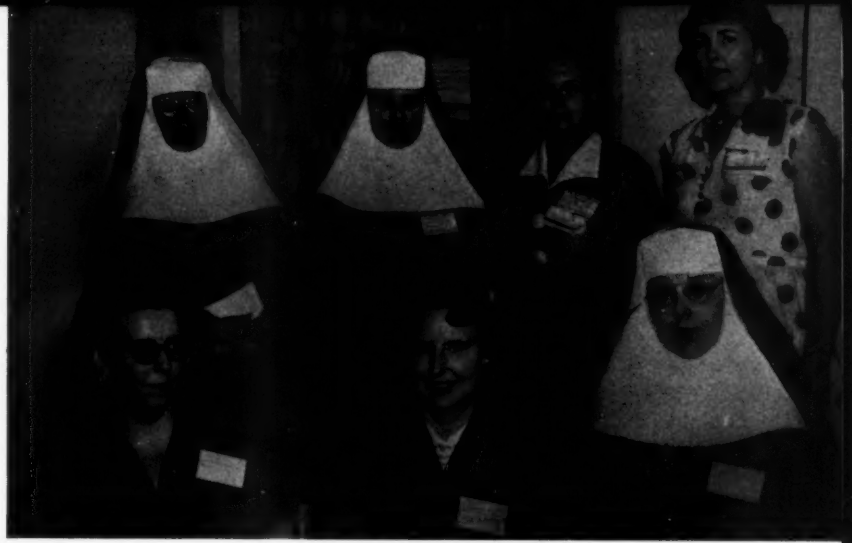
Mrs. Eley, and Allene Strack, St. Vincent's Infirmary; Mrs. Kerr and Lucille Ball, Davis Hospital, Pine Bluff; Gladys Beal, Edwinia Coley, Elizabeth Wilhite, Teresa Moore, and Harold Myers, VA Hospital.

Texas Groups form a State A. O. R. N.

OPERATING room nurses from throughout Texas met in Galveston during the Texas Hospital Association meeting to discuss organization of a state A.O.R.N.

Representatives of all local associations plus interested individuals were present. A brief history and summary was presented by the Dallas Association. The constitution of the Texas Graduate Nurses Association on special section was reviewed, and there was general discussion concerning the problems of starting a state association.

This group, to function for one year as the Texas Conference for OR Nurses, will be the nucleus for the state association. The conference shall be open to all graduate nurses actively engaged in operating room work in the state. Its purpose shall be to promote the advancement of



Officials of the new organization, shown at right are, back row (l. to r.): Sister Dorothea, San Antonio, public relations; Sister Mary Digna, Corpus Christi, publicity committee; Louise Torian, Dallas, publicity committee; Leola Scales, Houston, publicity committee. Front row (l. to r.): June Smith, Dallas, chairman; Joyce Adams, Houston, vice-chairman; Sister Theobalda, Amarillo, secretary; and Lucille Domer, Amarillo (not shown), publicity committee.

the interest in the development of surgical technic.

The Conference will attempt to have representatives from the area attend the meeting sponsored by the International College of Surgeons in September. Plans are being made for a state-wide meeting next spring to coincide with the THA convention. The conference felt that the demand for such meetings was present and this need should be satisfied.

Those attending were: Sister M. Rosaria, St. Joseph, Houston; Sister Mary James, St. Paul, Dallas; Mary E. Francis, Baylor, Dallas; Sister M. Theobolda, St. Anthony's, Amarillo; Sister Mary Digna, Spohn, Corpus Christi; Sister M. Dorothea, Santa Rosa, San Antonio; Sister Mary Denis, Hotel Dieu, Beaumont; Barbara Smith and Opal Crenwell, Memorial, Houston; Mrs. B. F. Peevey, Hollyce Hashings, and Josephine Ballard, St. Ann, Abilene; Louise Torian, Gaston, Dallas; Rose Ann Landall, Memorial, Lawton, Okla.; June Smith, Parkland, Dallas; Sister John Joseph, St. John's, San Angelo; Betty Hastings, Raymondville Memorial, Raymondville; Leola Scales, VA, Houston; Francis Kimbel, North Plains, Borger; Joyce Adams, Gloria McNamara, and Lee Teblett, Hermann, Houston; Edna Asby and Elizabeth B. Murphy, Veterans, Houston.

PEORIA (Ill.) Supervisors Form A.O.R.N.

A group of 38 operating room nurses, representing 18 hospitals in Peoria and the surrounding area, met at St. Francis Hospital recently for their first meeting. The Rev. J. Weishar gave the invocation. Sister M. Ethelburga, St. Francis Hospital, conducted the business meeting. Sister M. Borromea, also of St. Francis, was the guest speaker.

Officers elected after the business meeting and shown in the inset are (l. to r.): Jean Schmidt, Kewanee Public Hospital, Kewanee, and Myrtle Drum, Proctor Hospital, board members; Dorothy DeBolt, Methodist Hospital, secretary-treasurer; Sister M. Ethelburga, St. Francis Hospital, president; Beatrice Pearsall, Methodist Hospital, board member; Jean Becker, St. Francis Hospital, chairman; Lydia Hill, Proctor Hospital, vice-president.

CORPUS CHRISTI, TEX. A.O.R.N.

Mary L. Martin served as temporary chairman at the first meeting of the Corpus Christi group held at Spohn Hospital. Although only hospitals in the city were represented, nurses from hospitals in the surrounding area will be invited to future meetings. Members of the group shown above, are (l. to r.) Mary Martin, Luthelle Meseck, Mrs. Odessa Pickett, Mary Sloevik, Sister Mary Digna, and Mrs. Gisele Davenport.

MEMPHIS, TENN. A.O.R.N.

Operating room supervisors from hospitals in Memphis met May 29 at John Gaston Hospital. The first meeting was spent getting acquainted and making plans for the next meeting scheduled for September.

Members of the group are shown below. L. to r., they are: Mrs. Francis Ross and Mrs. Emily Burris, John Gaston; Mrs. June Parrish and Mrs. Eileen Stewart, St. Joseph's; Mrs. Jean McGowan and Mrs. Catherine Abel, Campbell Clinic; Mrs. Francis Martin, Memphis Eye, Ear, Nose & Throat, and Dorothy Turner, Baptist Hospital. Not present were Mrs. Sara Parker, Methodist; Mrs. Ruby Wester, West Tennessee Tuberculosis; Francis Cromwell, Veterans· Hatie Haigwood, U. S. Marine; Mrs. Gladys Wilkes, Oakville Sanatorium, and Mrs. Dorothy Capps, La Bonheur Children's Hospital.

Albuquerque Nurses Organize A.O.R.N.

● The newest group to be added to the list of Associations of Operating Room Nurses was organized in July in Albuquerque, N. Mex.

Officers of the organization are: president, Jane Withers, Bataan Memorial Hospital; vice-president, Marian Leech, Presbyterian Hospital; treasurer, Mrs. Jack, St. Joseph's Hospital; and recording secretary, Viola Hejtmanek, Veterans Administration Hospital.

All members are shown in the photograph above. Back row, l. to r., they are: Josephine Dougherty, Women and Children's Hospital; Jean Norris, Presbyterian Hospital; Mrs. North, Bataan Memorial Hospital; Mrs. Leech; Miss Cockerell, and Mrs. Nangez, both of Presbyterian Hospital; Mrs. Snell, St. Joseph's Hospital, and Viola Hejtmanek.

Sitting, l. to r., they are: Mrs. Cornine, Women and Children's Hospital; Mrs. Weeks, Veterans Administration Hospital; Jane Withers; Mrs. May, Bataan Memorial Hospital; Mrs. Gault, Presbyterian Hospital; Mrs. Casey, and Miss Hinman, both of Veterans Administration Hospital, Albuquerque.

Index

absorbable glove powder 54-72
accident reports in the operating room 140
administrator's responsibility to o.r. 44, 45, 46
air borne contamination in o.r. 135, 136
air conditioning in o.r. 26
ampoules, disinfection of 78
anesthesia machines 86, 87
anesthesiologist in o.r. 43, 44
anesthetising area, rules for 112
blanket, electric in surgery 80-82
blood, refrigeration of 100
blood vessel bank 19
body temperature, maintenance of in surgery 80, 81
boiling water disinfection 8
book reviews
  o.r. technic 41
  surgical nursing 83
carboxide gas in sterilization 6
catheters, sterilization of 16, 17, 74, 75, 79
cellophane wrappers 16, 17
Char-Lab 14
charring of wrappers 11
chemical disinfection 4, 5, 122, 123
  ethylene oxide in 6
  in homologous serum jaundice 6
cleaning instruments 14, 17, 18, 74
clothing in o.r. 25, 87, 88, 103, 111
conductive floors 79, 115, 116
conversion tables, temperature 28, 29
corrosion of instruments 143
cutting edge instruments, sterilization of 99, 100
cystoscopes, disinfection of 75
detergents
  in cleaning 17
  in skin disinfection 124
dirty case technic 73, 78, 136, 137
disinfection
  ampoules 78
  chemical 4, 5
  cystoscopes 75
  intubation tubes 101
  rubber goods 76
  skin 100, 101
  suture tubes 78
  urological instruments 137
dressing drums 74
dry goods, sterilization of 12
dry heat sterilization 6, 7, 8, 75, 76, 137
dyeing
  linen for o.r. 127, 128
  solutions 143
electric blanket in surgery 80, 82
electric equipment in o.r. 86
electric facilities for o.r. 108, 109
electric sterilizer 75, 76
electronics for sterilization 4, 5
electrostatics
  definition of 102, 103
  in o.r. 84-89, 102-119
emergency sterilization 15
energy exchange in steam sterilizers 11
ethylene oxide for sterilization 6
explosion hazards in o.r. 24-27, 84-89, 102-119
  causes of 84, 85
  hazardous area for 85
  incidence of explosions 84
  personnel factor in 109, 110, 113, 119
  safe equipment 25, 26
  testing equipment 117
flammable drugs 25
floors in o.r. 26, 79, 85-88, 104-107, 115, 116
  conductive 85-88, 104-107
gas bacillus in o.r. 136

Index (Continued)

gloves
- basin as source of electrostatic discharge 87
- powder for 54-72
- sterilization of 123

grafts, blood vessel 19

grounding equipment in o.r. 109

hexachlorophene in instrument germicide 99

homologous serum jaundice 6, 99-100

instruments
- cleaning of 14
- lubricating of 16
- neurosurgical 94-97
- sterilization of 6, 7, 9, 14, 74, 99, 100, 124
- washing 74

irrigation of wounds 123, 124

linen
- antistatic rinse for 113-115
- dyeing of 127, 128

markers for sterile solutions 143

neurosurgery
- instruments for 94-97
- nurse's responsibility in 92-97
- operating table for 97

oils, sterilization of 123, 136

operating table in neurosurgery 97

orthopedic surgery, skin disinfection for 101

outline for teaching 22, 23, 90, 91

operating room
- accident report in 140
- administrator's responsibility 44, 45, 46, 47
- anesthesiologist in 43, 44
- approved equipment for 100
- clothing in 25, 87, 88, 103, 111
- communicable disease in 101
- dirty case technic for 73, 78, 136, 137
- electrical equipment in 86
- electrical facilities for 108, 109
- electrostatics in 84-89, 102-119
- floors in 26, 79, 85-88, 104-107, 115, 116
- housekeeping in 142
- management project 52-54
- nurse's responsibility in 140
- orientation manual for 140, 141
- purchasing for 139, 140
- quarantine of 73
- safety in 24-27
- scheduling in 141, 142
- supervisor's duties in 44, 45
- surgeon's responsibility in 18, 19, 42, 43, 44
- teaching in 20-23, 38-41, 89-91, 120 121, 129-132, 133-135, 140
- ultraviolet in 124, 125
- walls, disinfection of 78
- work simplification in 34

Operating Room Nurses Associations
- Arkansas 151
- Hawaii 147-149
- Illinois, Peoria 154
- New Mexico, Albuquerque 157
- Oregon, Portland 146
- Tennessee, Memphis 156
- Texas 152, 153
  - Corpus Christi 155
  - Panhandle 150

packaging technic, requirements for 13

paper wrappers 16

personnel in o.r.
- responsibility of 109, 110, 111, 113, 140
- relationships of 141, 142

portable equipment in o.r. 107

powder for rubber gloves 54-72

process flow charts 32

purchasing in hospitals 47-50

quarantine in o.r. 73

radium, sterilization of 135

recovery room, responsibility for 139

restraints for child 77

rubber goods
- disinfection of 76
- sterilization of 14, 15

Index (Continued)

scheduling in o.r. 141, 142
shoes in o.r. 25, 88
silicones for instruments 16
skin disinfection 100, 101, 124
solutions, sterilization of 13, 14
steam sterilization, time required for 8, 9, 10
steam sterilizers for dry heat 75, 76, 137,
  noise in 125
sterilization
  by boiling water 8
  carboxide gas in 6
  catheters 16, 17, 74, 75, 79
  controls in 73, 74
  cutting edge instruments 99, 100
  dressing drums in 74
  dry heat 6, 7, 8, 75, 76, 137
  electronic 4, 5
  emergency 15
  ethylene oxide in 6
  gloves 123
  instruments 6, 7, 9, 14, 74, 99, 100, 124
  methods of 4-19
  moist heat 8, 9
  radium 135
  requirements for 9, 10
  solutions 13, 14
  superheating in 11, 12
  syringes 6, 7, 8, 17, 98, 99, 101
  textiles 10, 11, 12, 17
  time required for 8, 9, 10-13, 14, 15, 16
  tubing 14, 15
  VASELINE 101, 123, 136
  VASELINE gauze 75, 137
  water 123
students in o.r. 38-41
superheating in sterilization 11, 12
surgeon's responsibility in o.r 18, 19, 42, 43, 44
sutures 144
suture tubes, disinfection of 78
syringes, sterilization of 6, 7, 8, 17, 98, 99, 101
syringe washer 51
teaching in
  o.r. 120, 121, 129-132, 133-135, 140
  personnel 20-23, 89-91
  students 38-41
technic committee in o.r. 17
  organization of 137
technicians in o.r. 20-23, 89-91
temperatures, conversion tables for 28, 29
textiles
  charting of 11
  hydration of 17
  sterilization of 11, 12
time for sterilizing 8, 9, 10-13, 14, 15, 16
  boiling water 8
  dry heat 7
  moist heat 8, 9
tuberculosis, disinfection for 75, 78, 79, 101
ultraviolet in o.r. 124, 125
Underwriters' Laboratory Seal 100
urological instruments, disinfection of 137
VASELINE, sterilization of 101, 123, 136
VASELINE gauze, sterilization of 75
virus of homologous serum jaundice,
  destruction of 6, 99, 100
water, sterilization of 123
waxing o.r. floors 79
work assignments 23
work simplification 30-37, 52-54
wound irrigation 123, 124
wrappers
  cellophane 16, 17
  charred 11
  paper 16

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